EFFECTS OF COMPUTER-ASSISTED INSTRUCTION ON ACQUISITION OF SCIENCE PROCESS SKILLS, RETENTION, AND PERFORMANCE AMONG BASIC SCIENCE STUDENTS IN KANO, NIGERIA

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DOCTOR OF PHILOSOPHY IN SCIENCE EDUCATION

DEPARTMENT OF SCIENCE EDUCATION,
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ZARIA

NOVEMBER, 2017

DEDICATION

This work is dedicated to my late father Alhaji Shehu Bala Dambatta who never failed to comfort and help me in terms of sorrow and difficulty. May his Gentle Soul Rest in Perfect Peace

DECLARATION

This thesis entitled; "Effects of Computer-Assisted Instruction (CAI) on the Acquisition of Process Skills, Retention and Performance among Basic Science Students in Kano Metropolis, Nigeria". The whole of the work has been carried out by me, in the Department of Science Education, Ahmadu Bello University Zaria. The information derived from the literature has been duly acknowledged in the text and list of references provided. No part of this thesis was previously presented for another degree in this or any other institution.

Name of Student

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Signature Date

PhD./EDUC/23237/2012-13

CERTIFICATION

This thesis entitled " Effects of Computer-Assisted Instruction (CAI) on the Acquisition of Process Skills, Retention and Performance among Basic Science Students in Kano Metropolis, Nigeria, by Saudat Shehu BALA PhD./EDUC/23237/2012-13 meets the requirements governing the award of Ph.D. in Science Education, and is approved for its contribution to knowledge and literary presentation.

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OPERATIONAL DEFINITION OF TERMS

Process Skills: Process Skills are intellectual skills which can help the child in understanding the school subjects and in his approach to everyday life. They are means of learning that are peculiar and essential to the conduct of science.

Retention: The ability to store and remember things experienced or learned by an individual at a later time.

Lecture Method of Teaching: This is a teacher centered method of teaching, where the teacher dominate the activities in the form of talking and writing on the board while the students listen

Computer-Assisted-Instruction: This is an interactive instructional technique, whereby a computer is used to present instructional materials and monitor the learning that takes place.

ABBREVIATIONS

APSA: African Primary Science Association

BSPT: Basic Science Performance Test

CAI: Computer Assisted Instruction

CESAC: Comparative Education Adaptation Center

CLM: Conventional Lecture Method

NCSE: National Center for Science Education

NISP: Nigerian Integrated Science Project

NERDC: Nigerian Educational Research and Development Council

PCSWP: Personalized Computer Soft Ware Package

PPMCC: Pearson Product Moment Correlation Coefficient

PSAT: Process Skills Acquisition Test

SSCR: Secondary School Curriculum Review

TEL: Technology Enhanced Learning

ICT: Information Communication Technology

ABSTRACT

This study investigated "Effects of Computer-Assisted Instruction on the acquisition of Science Process Skills, Retention and Performance among Basic Science Students in Kano, Nigeria". The research design adopted for the study was a Quasi-experimental control group design which employed a pretest, posttest, and post- posttest of the experimental and the control groups. The population of the study consisted of 8,131 JSSII Students from forty-one schools in Kano Municipal. Four schools were selected as sample for the study with a total number of 200 students. The instruments used for the study were Basic Science Performance Test (BSPT) with reliability coefficient of 0.89 and Process Skills Acquisition Test (PSAT) with reliability coefficient of 0.76. Both instruments were validated by three senior lecturers. Intact classes of JSSII were used for the study. Six research questions were answered using descriptive statistic of mean and standard deviation, while six research hypotheses were formulated and tested using t-test at $P \leq 0.05$ level of significance. One of the hypothesis answered was There is no significant difference in the level of performance between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method Major findings of the study revealed that the use of Computer-Assisted Instruction (CAI) has positive effect on Students' acquisition of Science Process Skill, Retention, and Performance among Basic Science Students. Based on the research findings recommendations were made among which include, that the State Ministry of Education should provide adequate Information Technology gadgets such as computers and software/instructions which are the basic equipments needed for the implementation of Computer-Assisted Instruction as a method of teaching. Teachers and students should be exposed to the Computer-Assisted Instructions as an effective modern teaching technique for the improvement of Science Process Skills acquisition, Retention and Performance in Science.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Science and technology education plays a vital role in the socio-economic development of all nations. In view of this, developed countries like Britain, Australia, United States of America, Japan, to mention but a few are stressing the need for discoveries in fundamental materials of importance in all fields of sciences. This is done at an incredible rate through pursuing scientifically and technologically related programs in the institutions of learning. Bala (2010) asserted that in developing nations like Nigeria, various factors have contributed to the decay in the educational system, among which is the misinterpretation of the nature of science and science education which can as well lead to in appropriate teaching that reduces the potential impact of science education as a tool for development in Nigeria.

Adinoyi (2005) and Ibrahim, (2012) both opined that for a country to achieve national development, science and technology has to be taught in a well-structured pattern involving activities for both teachers and students. However the low performance of students in sciences as reported by the National Center for Science Education NCSE (2012) has put science education in the nation in a state of crisis. Efforts were made by various curriculum developers in Nigeria with a view to address this issue, for example, the development of the Comparative Education Study Adaptation Center CESAC (1968), the establishment of the Nigerian Integrated Science Project NISP (1971) as well as the Science Teachers Association of Nigeria STAN (1970). Samuel (2012) explained that the progress in the teaching and learning of science concepts still remained very slow, in spite of the introduction of the 6-3-3-4 system of education. However the problem of the implementation of the 6-3-3-4 system of education is partly due to the non availability of

personnel, materials, funds and administrative will. In view of this short coming the researcher intends to test the effect of computer assisted instruction on the acquisition of basic science process skills, retention, and performance among basic science students in Kano, Nigeria.

Abdullahi (2005) pointed out that Nigeria could not achieve national development as science education has been put in a state of crisis in the Nation. He further pointed out that for the country to achieve development the problems associated with science education have to be eradicated. Some of these problems include, poor teaching skills, non application of science to production activities, inadequate teaching materials, poor funding, and non implementation of research findings among others. These problems therefore have led to underachievement in science education as reported by Nwagbo (2008). The culmination of the above problems have made it difficult to develop scientifically literate individuals that will be willing to learn science contents as well as acquire the science process skills.

Basic science is the science taught at the primary and junior secondary level in Nigeria. The syllabus of basic science is designed with a lot of activities, as such methods used for its teaching should be in such a way that it will allow the learner to learn through the activity based method of teaching. NTI (2007) reported that methods of teaching basic science should include the guided discovery method which is resource based. The mastery of basic science concepts cannot be fully achieved without the use of instructional learning materials; hence the teaching of basic science without learning materials can result to the inability to recall the learned materials, and consequently result to lack of acquisition of the science process skills, poor retention ability as well as poor academic performance. Franzers, Okebukola and Jegede (1992) stressed that a professionally qualified science teacher cannot be able to put ideas into practice if

equipments and materials necessary to translate competence into reality are lacking. Yusuf (2009) described instructional or teaching materials like the computer, the projector and the like as those items used by the teacher to pass information to students. Achimugu (2000) posited that students comprehend and remember better when teaching materials are employed in the teaching-learning process. Some researchers' like Betiku (2000) and Ayua (2011) revealed that there are materials which can be used effectively to teach basic science in order to make learning experience effective. It is envisaged that instructional materials if carefully and properly planned may enhance the teaching and learning of basic science, and consequently make it enjoyable, interesting, and exciting. It is in this regard that this research work intends to use a personalize computer soft ware package as a form of teaching resource for the teaching of basic science in order to asses if it will be effective in the acquisition of science process skills, retention and performance among basic science students in Kano Metropolis, Nigeria.

Okeke (2015) narrated that as a former British Colony, Nigeria's' system of education is patterned like the British system in many ways. Before the advent of Nuffield junior science in 1960s, the only form of science was Nature study. The priority of the primary school curriculum as at that time was vested on the 3Rs (Reading, Writing, and Arithmetic). In 1960 Nigeria's primary concern was to develop science in order to improve its economy so as to catch up with the developed world. Science is seen as a subject related to material progress. Yeung (2001) explained that in order to improve the nations' economy, regional and international conferences were organized, which subsequently led to the establishment of elementary science project in 1964, followed by the African Primary Science (APSA) in 1965 hence the race to develop integrated science begun. The objectives of the program as outlined by Fafunwa (1974) are to develop interest in science and technology, take advantage of the numerous career opportunities

offered by the study of science and technology, and preparedness for further studies in science and technology among others.

Among the numerous curriculum efforts and innovations in sciences was the UBE, which was formally launched in 1999 by the Federal Republic of Nigeria. Its aim was to ensure adequate and qualitative education that is directed towards the achievement of the Nations objectives as well as provide a universal, free, compulsory, and continuous nine (9) year education programme. In line with this, the Nigerian Educational Research and Development Council (NERDC) developed a new nine (9) year basic education curriculum that has the following components: Lower Basic Education Curriculum for primary 1-3 (age 6-8years). Middle Basic Education Curriculum for primary 4-6 (age 9-11) Then the Upper Basic Education Curriculum for Junior Secondary (JS1-3) (ages 12-14) Adeyinka (2002) narrated that generally, the new areas of emphasis in the new nine (9) Year Basic Education Curriculum are: Value Re-orientation, Basic Science, Basic Technology, Computer Science, Home Economics, Agricultural Science, Business Studies, Civic Education and French. Danmole (2000) stated that in the Nigerian Education Continuum, basic education as the foundation requires a sound knowledge of science and technology, because science teaching is virtually non–existent in the Nigerian primary schools. Therefore, the nine (9) years Basic Science and Technology Curriculum is a re- structuring and re- alignment of the revised core curriculum for Primary Science and the Integrated Science for the Junior Secondary Schools which is currently in use.

Mamudu (2013) reported that in spite of the above efforts the teaching and learning of science in Nigerian schools hardly follows the nature of science. What is rather obtained is shallow rooted instruction that leads to superficial acquisition of knowledge, which cannot be appropriately applied in or out of school situation or lead to a successful achievement in learning. Other problems associated with the teaching of basic science at

the junior secondary school level includes the quality of curriculum delivery, production and provision of instructional materials, enrolment and class size, to mention but a few. Consequently, this has rendered the learning of basic science to be difficult, un-interesting, abstract, and in some cases meaningless. In view of this Adesoji and Raimi (2004) suggested that better programme should be adopted for the teaching of basic science with the hope of attaining and achieving effective classroom teaching that can produce individuals who will at the end acquire the necessary process skills, achieve and retain better what they have learnt in order to be productive in the society. In view of these problems this research work intends to provide the necessary empirical data that will show the effect of the use of Computer-Assisted Instruction on the acquisition of Process Skills, Retention and Performance among Junior Secondary School Students in Kano Metropolis, Nigeria.

Science being the study of nature can be considered as the search for facts and beliefs in rational answers to questions about the nature of life and the universe. In pursuing those answers, scientists try to adhere to particular rules and habits of thoughts that have proved reliable in the painstaking process of building up increasingly dependable pictures of the world. The method of science, therefore, is a process or procedure of arriving at scientific facts. Clark (2009) explained that the most distinguishing feature of science is the method it uses for exploring about the universe. It is an activity that takes place in the mind as a result of certain intellectual processes, which are means by which one can examine the unknown, explore, and investigate through experimentation and analysis of the environment. There is no one scientific method but there are certain general principles that govern scientific processes. For example, process skills are means of learning that are peculiar and essential to the conduct of science and they can be termed as tools that are used to investigate the world around us and construct science concepts. Mifflin (2002)

outlined process skills as the art of reasoning, cognitive development, critical and logical thinking, which generally includes observation, communication, measurement, comparison, contrasting, organizing, classifying, analyzing, inferring, hypothesizing, predicting among others. He went further to say that the development of concepts depends on process skills because concepts and process skills are interrelated. Some studies by Miller and Wayne (2008), Suwaid (2013) revealed that process skills are means that help the child to understand school subjects as well as assist in the approach to everyday life.

Miller and Wayne (2008) explained that science process skills are regarded as general cognitive skills that man routinely employs and are classified into basic process skills and integrated process skills. Nay (2007) explained that basic process skills are six in number and are appropriate for children in the primary grades. They include; observation, measurement, classification, communication, prediction and inferring. While the integrated process skills are eleven in number and are appropriate for grades four and above. They include; formulation of hypothesis, identifying variables, defining variables, describing relationships between variables, designing investigations, experimenting, acquiring data, organizing data into tables and graphs, analyzing investigations, understanding cause and effect relationships, and formulating models. For the purpose of this study, the researcher intends to test the effect of Computer Assisted Instruction in relation to Skills Acquisition, Retention and performance among basic science students, as the basic process skills are appropriate for students that are in the basic education level.

Jiya (2007) states that literally, the ability to store and remember ideas and facts is termed as retention. Ochonnogor (2007) wrote that retention can be measured through verbal recall of learnt materials, and explained that concepts learnt assist in reflective thinking and that retained concepts can be used in creative ways to solve new problems.

Retention and performance in science, technology, and mathematics, are of paramount importance in science learning. Bichi (2002) also described retention as the ability to store and remember things experienced or learned by an individual at a later time. Oyedokun (2002) and Jiya (2007) argued that when teaching is characterized by rote learning, meaningless memorization, or verbalism, students learn ineffectively. However, Bichi (2002) believed, when there is interference among learned material; speed and efficiency of learning is often decreased. Where as anything that aids learning should improve retention. Thus learned facts cannot be retained for a long time, nor can they have a significant effect on the learning outcome. Therefore, this research work intends to assess the effect of the use of Computer-Assisted Instruction on process skills acquisition, retention and performance among basic science students.

Performance can be explained as a term, which is directly proportional to change in a learning context, input, or classroom process. Performance, therefore, simply means the extent to which a student, a teacher, or an institution has reached its educational goal. It is commonly measured by examinations or other means of evaluation of teaching and learning outcome. In another development, Sati (2014) described performance as a complex students' behavior that underlies several abilities. Examples include memory, previous knowledge or aptitude, as well as psychological factors like motivation, interest, temperaments or emotions. Deary, Whiteman, Star, Whalley and Fox (2004) stated that performance can either be low or high. Adamu (2008) explained that the causes of low performance are diverse and cannot be associated with a single factor. For instance, proponents of self-concept and its variables may be a paramount factor in academic failure. Yoloye (2009) reported that performance in any form of activity is based upon study interpretation and application and that study has a purpose so it depends on the individual to decide why he or she wants to study. That is, either to gain new ideas or to

find out relationship between two different things. In essence, what one learns as a result of study depends on the degree to which one succeeds. Hard work involves having common sense and using better organization and application of good study habit. Nwagbo (2001) and Penil, Olorukooba, Usman and Lawal (2007) revealed that students perform poorly in science secondary schools and a number of factors were found to be responsible for the poor attainment of the objectives of science instruction. Some isolated factors as deduced by some researchers like Nwagbo (2006) and Abdullahi (2005) include inappropriate and uninspiring teaching approaches adopted by science teachers, inadequate teaching and learning facilities and so on. In this research the researcher intends to find out if the use of computer assisted instruction can help students to acquire skills that can be extended to out of classroom situation, to be able to recall the concepts being taught in the classroom, as well as improve academic performance in science learning.

Another variable for this research is Gender. In line with this research, gender can be explained as an identifiable human characteristic that can affect the level of process skills acquisition, retention and performance among basic science students. The academic performance of males and females in science, technology and mathematics has been perceived differently, where males are rated higher than females (Bello, 2002).Researchers in science education such as Bichi (2002), Linver, Davis-kean and Eccles (2002), have expressed concern on gender related issues with the view of improving science teaching and learning. Jimoh (2005) reported that the position of females in science, mathematics and vocational education is below average when compared to males. Ahmad (2008) reported that studies have shown that girls and boys have different attitudes towards studies. Patrick and Ezenwa (2000) narrated that considerable numbers of researchers have focused on gender differences in science

learning. Lagoke (2007) noted that boys perform better than girls in activities that require manipulations, and boys are said to be more mechanically and scientifically inclined than girls. However other researchers like Mari (1994) observed that female students perform better than male students. Bichi (2002) Danmole and Adeoye (2004) in their separate studies found that there is no gender difference in the performance of boys and girls in sciences. From these studies, there is no conclusive statement on gender related issues investigated by the researchers. It is due to this inconclusive decision that this study intends to investigate on the effect of computer assisted instruction on the acquisition of process skills, retention and performance among basic science students and also to determine if there is any significant difference in terms of the level of acquisition of science process kills, retention and performance among male and female basic science students.

Inyang (2009) narrated that the educational benefits of Information and Communication Technology (ICT) in building up a generation of technological and skilled individuals must be appreciated. Most countries have come up with programs and policies that will enhance the use of ICT in the business of teaching and learning. The Center for the Advancement of Teaching and Learning CATL (2001) also in a mission statement "Towards the definition of online learning" at the university of Western Australia submits that online learning is a subset of flexible teaching and learning. Students and teachers subscribe to online learning approach in order to achieve the desire for flexible learning. According to Yeung (2001) online instruction facilitates the acquisition of knowledge and skills. Wal and Linde (2001) and Olajide and Lawal (2012) all explained that Computer Assisted Instruction (CAI) is another development in search for more efficient training that will involve the integration of computer assisted programs for the development of quality teaching and learning. Hung (2011) reported that CAI is used in educational drill

practices, testing, tutorials, games, accumulative records and simulations. And he went further to say that CAI provides and enhances retention, motivation, high performance, and good quality of written work, timely interaction with the teacher, and immediate feedback as well as positive attitude towards the learning process. Therefore this study is intended towards assessing the effect of computer assisted instruction on acquisition of the science process skills, retention and performance among basic science students.

Some studies on computer assisted instruction like Johnson, Aragon, and Sheik (2000), Martin-Michiellot and Mendelson (2000), Clark (2009) compared learning methods in human resource development. Their findings showed that students in the Computer-Assisted group perceived the instructor more positively and rated the overall course quality higher than their counter parts. Their study also revealed that students who were taught using multimedia tools combined with cooperative learning had increased students satisfaction and better learning outcome. Clark (2009) further deduced that materials delivered in an easy to learn fashion can enhance students' performance and satisfaction which signifies that "learner ability" refers to the degree to which a student learn the course contents and materials delivered through computer assisted instruction or lecture method easy to learn. Thus from the foregoing account it has shown that the use of computer assisted instruction may serve as a foundation for the achievement of a deep understanding of the complex ideas that are embedded in ICT as well as provide an avenue for the constant practice and mastery of science process skills. In view of this the researcher intends to find out the effect of computer assisted instruction on the acquisition of process skills, retention and performance in science learning among basic science students in Kano Metropolis.

1.1.1 Theoretical Framework

The theoretical framework for this study is based on the constructivist theory of learning which according to Piaget (1940) believes that knowledge is not received passively, but it is built up by the cognizing subject. In other words, it is not possible to transfer ideas into students' head, rather students have to construct their own meaning from the words they hear or the visual images they see. In this regard the use of computer assisted instruction will make the students to participate actively in the learning process, provide the students with the appropriate conditions and materials that will stimulate the learner to construct his own learning model. Although an individual has to construct his own meaning of a new phenomena or idea, the process of construction is always embedded within the social context of which the individual is part. Saunders (2002) stated that "Knowledge is the result of an individual subject constructive ability not a commodity that somehow resides outside the knower, and can be conveyed or instilled by diligent perception or linguistic communication. The constructivist view of learning considers learning to be an individual and personal event, hence people construct, re-construct, and deconstruct their own understanding and knowledge of the world by experiencing things and reflecting on those experiences.

Clark (2003) decided that the focus of teaching is that of guiding the students, as they build and modify their existing mental models, which denotes a focus on knowledge construction rather than knowledge transmission. They further explained that constructivism as a paradigm of learning is founded on the premise that by reflecting on past experiences one can construct his/her own understanding of the world they live in, generate his/her own rules, and design his/her own mental models which he/she can use to make sense of his/her experience. In this context, the use of Computer-Assisted Instruction will give the learner a chance to be an active contributor in the classroom

rather than being a passive listener and this will consequently enable him/her acquires skills that could be use in solving educational problems in particular and societal problems in general. More over it will provide the learner with an experience that will help him/her to reflect on his experiences and consequently make quick recall of the learnt materials. The use of Computer-Assisted Instruction can make the learner to become an active thinker and consequently perform better in their various educational endeavors.

Abdullahi (2012) narrated that Ideally computer assisted instruction can serve as a guide, as well as provide an avenue for conducting activities for the students, so that they can be able to build and modify their existing mental models that can aid in retention and improve performance. In line with this study the use of computer assisted instruction will make the learner to become motivated to make his own personal construction of knowledge through interaction between the individual knowledge scheme and his experiences with the environment.

Some pedagogical theories of learning like the cognitive view of learning, according to Garbela, (2004) states that for learning to take place students actively process information by making efforts to organize, store, and find relationships between information, linking new knowledge to old knowledge schema and scripts. Thus Ausubel (1962) considers the impact of prior learning as a decisive factor in information processing. Cognitive theory therefore emphasizes the way information is being processed, that is the active and mental process on the part of the learner; all of which are embedded in computer assisted instruction. Therefore in this research the use of personalize computer soft ware package will engage the learner with activities that can boost his/her mental capability. In such a way the learners' tendency to acquire skills may be enhanced, retention ability may be stimulated by recalling the activities that were done

through the use of the PCSWP in this regards the researcher intends to assess the Effect of Computer Assisted Instruction on the acquisition of Science Process Skills, Performance and Retention among Basic Science Students in Kano Metropolis.

Another theory that is guiding the use of Computer-Assisted Instruction is that of Piaget (1977), which suggested that people learn through exploration, and that learning occurs when the students' exploration uncovers an inconsistency between their current knowledge representation and their experience. This study is relative to the use of Computer-Assisted Instruction in the sense that the use of PCSWP will involve the learner in the teaching and learning process rather than being passive as in the lecture method. Therefore, the learner will be able to explore quite vividly not only try to imagine what the teacher has said in the conventional lecture method. Smeet and Moji (2001) explained that students' retention ability and performance can only be improved when teachers creates an interactive learning environment that stimulates students to be active, cooperative, and take more responsibility in the learning process. So in line with this study the use of PCSWP as a media of instruction can make the learner to be active, cooperative as well as take owner of his own learning, which may consequently boost the level of retention and improve performance among learners.

1.2 Statement of the Problem

Research studies like Anthony (2002) and Abdullahi (2005) stated that in Africa, the teaching and learning of Basic Science is dominated by the lecture method and is thought to be the major reason for learning disability and lack of interest on the part of the learners. The National Policy on Education (FME, 2013) states its objectives for science education is to cultivate the spirit of inquiry, produce competent scientist and to provide knowledgeable scientists. Usman (2014) called on the need to transform the teaching of

science with a view to assisting the teaming youths to acquire skills that will make them self-reliant.

Muoneme (2013) explained that the teacher and his method of teaching may have been the major cause of student's poor academic performance in basic science as most teachers still prefer using the "chalk and talk" method i.e. the lecture method. The lack of trained teachers that can alter the conventional teaching methods to modern teaching strategies, as well as non use appropriate instructional ,material for the teaching and learning process are all identified by Elechi (2003) as factors resulting in poor performance among learners of science. The situation in Kano State is a clear indication of the poor performance. Tables 1.1 and 1.2 showed inconsistencies in the performance of students in Basic Science and Basic Technology in the Basic Education Certificate Examinations over the years.

Table 1.1: Performance of Students in Basic Science in the Basic Education Certificate Examination (BECE) in Kano Metropolis (2010 – 2015)

Year	Students who sat for the exam (%)	Passed with distinction and credit (%)	Passed with P7-P8 (%)	Failed (%)
2010	98	37	17	43
2011	99	40	34	25
2012	98	67	21	10
2013	98	78	15	5.0
2014	98	62	24	1.0
2015	98	60	22	16

Source: (Kano Educational Resource Department, (2015)

From Table 1.1 a look at the percentage of students who failed and those who passed in the BECE examinations is not consistent. For example in 2010 the percentage failure is (43%) with only 37% having distinction and credit while 17% with P7 and P8. Also in the year 2011, 25% failed 40% with distinction and credit and the remaining 34% passed with P7 and P8. In 2012 the percentage failure is (10%) with 67% having distinction and credit while 21% passed with P7 and P8. In 2013 the percentage failure is (5.0%) with 78% having distinction and credit while 15% passed with P7 and P8. In 2014 the

percentage failure is (1.0%) with 62% having distinction and credit while 24% passed with P7 and P8. In 2015 the percentage failure is (16%) with 60% having distinction and credit while 22% passed with P7 and P8. The problem in the teaching of basic science at the grassroots is overhauled. The trend is similar in the performance of the students in Basic Technology. Table 1.2

Table 1.2: Performance of Students in the Basic Technology Certificate Examinations (BTCE) in Kano Metropolis from 2010 – 2015

Year	Students who sat for the exams (%)	Passed with distinction and credit (%)	Passed with P7-P8	Failed (%)
2010	99	41	17	41
2011	99	43	32	24
2012	99	31.7	26	41
2013	99	73	17	9
2014	98	40.8	27	30
2015	98	36.5	29	32

Source: (Kano Educational Resource Department, 2015)

Table 1.2 indicated that the percentage scoring P7, P8 and failed added up together, indicate large failure rate. This according to Afuwape and Olutoye (2004), Odetoyinbo (2004) has prevented students from offering or performing well in the core science subjects at the senior secondary level. The result also indicated that the number failing is greater than those passing. The use of activity methods like the Computer-Assisted-Instruction has been reported by researcher Yeung (2001) to aid learning, especially sciences subjects. This study therefore seeks to investigate the Effect of Computer Assisted Instruction on the Acquisition of Science Process skills, Retention and Performance in Science learning among Basic Science Students in Kano Metropolis, Nigeria.

1.3 Objectives of the Study

The main objectives of this study are to:

i. find out the difference in performance among students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method

ii. examine the difference between the Science Process Skills Acquired in students that were taught Basic Science concept using Computer-Assisted Instruction (CAI) and those taught using Lecture Method

iii. determine the difference in the level of retention among Students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method

iv. investigate the difference in the level of Performance between male and female students taught Basic Science concept using Computer Assisted Instruction

v. examine the difference in the level of Science Process Skills acquired between male and female students taught Basic Science concept using Computer Assisted Instruction

vi. find out the difference in the level of retention ability among male and female students taught Basic Science concept using Computer Assisted Instruction

1.4 Research Questions

The following research questions are put forward to guide the study:

i. What is the difference in the level of performance between students taught Basic Science concept using Computer-Assisted Instruction and those taught using lecture method?

ii. What is the difference in the science process skills acquired in students that were taught Basic Science concept using Computer-Assisted Instruction (CAI) and those taught using lecture method?

iii. What is the difference in the retention ability between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method?

iv. What is the difference in the level of performance between male and female students taught Basic Science concept using Computer Assisted Instruction?

v. What is the difference in the level of the science process skills acquired between male and female students taught Basic Science concept using Computer-Assisted Instruction?

vi. What is the difference in the level of retention between male and female students taught Basic Science concept using Computer-Assisted Instruction?

1.5 Null Hypotheses

Based on the research questions, the following null hypotheses were formulated to guide this study. The null hypotheses were tested at $P \leq 0.05$ levels of significance

$H0_1$: There is no significant difference in the level of performance between students taught Basic Science concept using Computer-Assisted-Instruction and those taught using lecture method.

$H0_2$: There is no significant difference in the acquisition of Science Process Skills among students taught Basic Science concepts using Computer-Assisted-Instruction and those taught using lecture method.

$H0_3$: There is no significant difference in the level of retention between students taught Basic Science concept using Computer-Assisted-Instruction and those taught using lecture method.

$H0_4$: There is no significant difference in the level of performance between male and female students taught Basic Science concept using Computer-Assisted-Instruction.

$H0_5$: There is no significant difference in the level of science process skills acquired between male and female students taught Basic Science concept using Computer Assisted Instruction.

$H0_6$: There is no significant difference in the level of retention between male and female students taught Basic Science concept using Computer Assisted Instruction.

1.6 Significance of the Study

The finding of this study might improve the teaching strategies and broaden students' knowledge, steer up their interest in Basic Science subject in the junior secondary schools in the study area and the nation at large.

It is hoped that finding of this study would build a proper link between students' performance in Basic Science and the quality needed for teachers' effectiveness in handling the subject across the state. It is also hoped that the findings of this research work will as well help to reduce the extent of preparation on the part of the teacher, thereby making presentation easier and interesting. The visual impact and interactive nature associated with the use of CAI can help to minimize the abstractions that are associated with the teaching and learning of science concepts therefore will make the teaching of science concrete and familiar

On the part of learners, it is hoped that the findings of this research work can help them to appreciate the skills being acquired using CAI by enabling them to solve problems both within and outside the classroom. The constant handling of computers using CAI will also help to intimate learners with the programs and features of computers, as well as make

them to be familiar with the internet. The findings of this study will provide a foundation for the achievement of a deeper understanding of ICT. It is also hoped that the findings of this study will encourage the learners to be creative; therefore will give them an opportunity to have a proper mastery of the science process skills. Generally, the findings from this study can help to improve the flow of applicable knowledge, skills, capability, and expertise on the part of the learners. The developmental problems encountered in secondary schools, which sometimes shift students focus from academic performance to social relationships may be addressed by the use of CAI learning tools.

This research finding can be of help to professional bodies like the Science Teachers Association of Nigeria (STAN) as it will have a new area of interest that will help to actualize vision 2020 meant for global technological advancement. The findings of this study will help in the creation of business opportunities on the part of book publishers, manufacturers, and distributors of various technological devices all over the globe.

1.7 Scope of the Study

This study seeks to investigate the Effects of Computer –Assisted Instruction (CAI) on Acquisition of Science Process skills, Retention and Performance, among Basic Science Students in Kano Metropolis, Nigeria. Kano Metropolis is made up of eight Local Governments areas. The study is delimited to Junior Secondary two (II) Students; because they are not under stress of any external examinations. The population of the study encompasses all the Junior Secondary School Students in Kano Municipal Local Government with a total number of 8,131 students drown from 41 Junior Secondary Schools. 4,870 were male student while 3,261 were females. A sample of 200 students were drown from four schools 2 of the schools were male while the other 2 were females.

The researcher used Computer-Assisted Instruction to teach Basic Science concept so as to assess its effect on the acquisition of Science Process-skills, which includes the skills

of observation, measurement, classification, communication, prediction and inference. In carrying out this research, two groups were involved and experimental group and the control group. Two instruments were also used, which include Basic Science Performance Test (BSPT) and Process skills Acquisition Test (PSAT).

The topics taught were:

i. Concept of environmental pollution

ii. Types of pollution

iii. Air pollution, causes, effects, and control measures

iv. Water pollution, causes, effects, and control measures

v. Land pollution, causes effects and control measures

vi. General overview of pollution

The concept of pollution was taught in the cause of the research because it forms part of the JSS syllabus, and it is a very wide topic therefore difficult for the teacher to cover within the stipulated time. And most of the time questions are often asked on pollution concepts during WAEC and NECO examination and the student would not escape answering question on the pollution concept (Bala 2010)

1.8 Basic Assumptions

For the purpose of this study, the following assumptions are made:

i. Computer -Assisted Instruction (CAI) is not being used for the teaching of basic science in the selected schools.

ii. The subjects for the study are taught by qualified science teachers.

iii. The schools are homogenous in the area of provision of equipments, instructional, Materials, Staff qualification, and motivation as well as students enrolment.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

There are various teaching techniques that can serve as means of imparting scientific knowledge to the learner. The focus of this study is to determine the effect of Computer-Assisted Instruction on process skills acquisition, retention and performance among basic science students in Kano, Nigeria. In this chapter literature relevant to the study are reviewed under the following sub-headings:

2.2 Historical Development of Science Education in Nigeria

2.2.1 Nature of Junior Secondary Schools in Nigeria

2.2.2 Teaching of Science in Nigerian Junior Secondary Schools

2.2.3 The objectives of Basic Science in Nigerian Basic Education Program

2.2.4 Resources for teaching science in Nigerian Basic Schools

2.2.5 Instructional Techniques of Teaching of Science

2.3 Use of Computer-Assisted Instruction (CAI) in the teaching of Science

2.3.1 Information Communication Technology

2.3.2 Virtual Field trip Instructional Strategy

2.3.3 Multimedia Teaching Strategy

2.4 Performance in Basic Science among Junior Secondary School Students

2.5 Science Process Skills and Science Learning

2.5.1 Models of Process Skills

2.6 Retention of learned concept in Science

2.7 Gender issues in Basic Science and Technology

2.8 Overview of Similar Studies

2.9 Implication of Literature Reviewed on the Present Study

2.2 Historical Development of Science Education in Nigeria

The Nigerian educational system started slowly but soundly developing during the colonial time until the end of the Second World War. The Christian missionaries introduced western education system in Nigeria in the mid-nineteenth century. Prior to 1859 no science was taught in any school in Nigeria. Fafunwa, (1974) explained that the first secondary school established in Nigeria was the Church Missionary School (C.M.S) in 1859. It was called the C.M.S. Grammar School, Lagos, Nigeria. Arithmetic, Algebra, Geometry, and Physiology, were introduced into the school curriculum. He continued to write that between 1859 and 1929 when a number of secondary schools and teacher training institutions were founded, science subjects such as Astronomy, Chemistry, Geology, Physiology, and Botany featured in their curriculum. He further reported that when Phelps-Strokes funded education commission and visited West Africa in 1920, it discovered that the state of science education was deficient, consequently a strong recommendation for the inclusion of science subjects in the curriculum of all secondary schools was made, and even then there were very few competent science teachers.

Bichi (2009) explained that before independence in the year 1960 most secondary schools in Nigeria emphasized classics and art subjects. At the lower secondary schools general science was taught while a few privileged schools like government and missionary schools taught physics, chemistry, and biology, in the senior forms. As an alternative to biology, health science was taught and taken in the school certificate examination in the final year of the secondary school course. He further explained that the science content in schools was dictated by an external examination board (Cambridge and London Universities Examinations Syndicates) with little or no regards to peculiarities in Nigeria.

Ben (2009) reported that the Ministry of Education inspected and recommended schools for recognition of their science teaching and learning process. In most cases, the order of

approval was biology, chemistry, and physics, but in some few cases, a school had approval for the three science subjects at once. He asserted that the attainment of political independence in 1960 marked the beginning of a new era in a number of activities in Nigeria. Modifications in a number of National issues became a common feature soon after 1960. In education, more institutions were established to cope with the increased demand for formal learning. For example, a new emphasis was placed on science teaching and learning especially at the secondary school level. Secondly, the dimension of courses available in our educational institutions were increased and made more relevant in the needs of the country, particularly science. Agriculture and technical courses began to acquire their due positions in the scheme of things. At the end of the first ten years of independence, curriculum development movements became established, and concrete efforts at the innovations began to manifest their reality. Before the independence, education in Nigeria was mainly aimed at acquiring a general education with no particular orientation towards vacation. Secondary education was defective since science was not taught at the primary level, and many secondary schools as well did not do science at all. The few that did were not able to provide adequately for the students. In a nut shell the historical development of science education in Nigerian schools followed the following trend:

In 1960s science was taught in the form of Nature Study in Nigerian primary schools. However in line with the demands for National development, certain modifications were made. In 1970s general science was introduced into the Nigerian secondary schools by STAN which was as a consequence of the various curriculum movements that were in line with the demand for national development.

According to Atanda and Bello (2009) the Basic Science curriculum has changed the Nigerian education system from 6 - 3 - 3 - 4 to 9 - 3 - 4. This was intended to reduce

drastically the incidence of drop out from the formal school and also ensuring the acquisition of the appropriate levels of: literacy, numeracy, manipulative, communicative and life - long skills for laying a solid educational foundation. Basic science curriculum is a revised curriculum of the former primary and junior secondary integrated science which was spiral in nature and thematic in approach i.e. themes cutting across all the sciences. STAN (2004) stress that "you and your" home is one of the six themes. The contents now include the issues of shaping the development of the nation identified as globalization, Information Communications Technology (ICT) and entrepreneurship. Therefore, four areas of curriculum innovations were infused in the Basic science curriculum, they are:

- Environmental Education (EE)
- Drug Abuse Education (DAE)
- Population and Family Life Education (POP/FLE)
- Sexual Transmitted Infection (STI, HIV/AIDS)

Therefore, Basic science as a subject had its initial pace through curriculum review on sciences by STAN and is offered at Upper Basic (JSS) level. The curriculum is aimed at exploring and acquainting the young child with the environment and also widens their power of thinking, reasoning for further scientific study and provides the trained manpower in applied science to the nation (National Policy on Education, FME, 2013). Thus, the course plays a vital role in preparing young pupils for higher scientific study and appropriate choice of science related careers and professions. This basic approach leads to the introduction of subject curriculum offered at the junior secondary school called integrated science, now known as Basic science.

Basic science, formally called integrated science is the grass root of science. Ibe (2008) defined Basic science as a subject, which emphasizes organization of learning experiences around common theme and stresses on the unification of concepts around

common themes thereby removing the subject matter boundaries. More so, Datom (2015), views Basic science as the subject that emphasized on the acquisition of modern science and such that enable young people to have access to new knowledge of bringing change in their minds and skills in order to behave rationally and creatively towards problem generated by change. A view of literature reveals that a straightforward definition of Basic Science is an approach to the teaching of science in which concept and principles are presented so as to express the fundamental unity of scientific thought and avoid pre-mature or undue stress on the distinctions between the various scientific fields (Bajah 1983). Furthermore, National Teachers Institute (2007) defined Basic Science as a conceptual unity of science. This definition suggests that there are certain concepts that are common to all the sciences e.g. energy. It is also identified as a unified process of scientific enquiry because Scientists go about their work in the same way-they collect and analyze data, make observation, inference and conclusion. Emeke and Odetoyinbo (2003) stress that the emphasis of the Basic Science program is on the development of the spirit of enquiry as opposed to rote learning as well as the development of manipulative skills and scientific attitudes rather than accepting scientific fact as a dogma. What one finds widely discussed are qualities and advantages of Basic Science. Brown (2007) suggested four (4) broad features of Basic Science, which are;

i. Unity of all knowledge
ii. The conceptual unity of science i.e. various concepts are merged together to make up the framework and later identified as a simple concept.
iii. A unique process of scientific inquiry
iv. An interdisciplinary study, which lay emphasis on viewing subjects as topical of the theme level from different viewpoint

Based on the above features, it becomes clear that the essence of Basic Science Course is to teach student what science is and how scientists work.

2.2.1 The Nature of Junior Secondary Schools in Nigeria

Abdullahi (1982) revealed that the teaching and learning styles laid much emphasis on the teacher as an authority. Consequently, rote learning of facts predominated; laboratory facilities were scanty; science personnel were few and the content and context of science courses were left to be improved upon. Abdullahi (1982) added that the curriculum was shallow in content and religion based; this led to the 1982 education ordinance, which underwent series of criticism and later revised by 1887 ordinance. Therefore, the system of education that is currently in use is known as the 9 - 3 – 4 system of education which is envisaged by the former education system. The first 9 years of Education is considered the Basic Education, which is a significant factor in the development of education in Nigeria.

2.2.2 The Teaching of Science in Nigerian Junior Secondary Schools

Teaching of science at the Basic levels essentially requires the use of instructional methods that will enhance meaningful learning and acquisition of skills, thus, making science teaching very easy with many activities and concepts involved. Good human resources will produce good learning resources, which will also help learners to improve on their performance and achieve greatly in their learning endeavours. Okebukola (2002) noted that no one method or theory is the best hence new innovations and strategies are also suggested in teaching. Moreover, the frequencies with which the teacher changes his/her teaching method will depend on the concept, skill or attitude to be developed in the students, which depends on these factors to be considered: the age of the students, the topic to be taught, the size of the class, the available resources at the teacher disposal and the timing of the lesson to be taught.

Rao (2003) stated that in education the word ‘method’ means the mode by which the material is communicated from the teacher to the student. It is the way teachers’ impact knowledge and skills while teaching and students comprehend knowledge and acquire the skills in the process of teaching. According to Gbamanja (1991) there is no one method of good teaching. The method to be employed will depend on the subject matter, the students, the teacher and the environmental variables. Therefore, it is very important to know the prevailing conditions regarding time, place and human nature in the shape of the learners, teachers, parents, and society generally. Ogunleye (2008) mentioned that science teachers are to vary their teaching methods on the demands of the situation they may find themselves. A combination of two or more method may better achieve the desired effect than a single method. Rao (2003) observed that there are many methods of teaching but science selects a particular method based on the needs of the content, teaching facilities available, and ability of the students and the philosophy of the teacher. He categorized teaching into three; namely Oral methods, which include Narration, recitation, lecture and discussion method. Secondly, activity methods, which include demonstration method, activity method, project method, laboratory method, discovery learning/inquiry approach, problem-solving method and supervised study. Thirdly, special methods, which include programmed learning, team teaching, computer assisted learning and personalized system of instruction. In addition, Atadoga and Onaolapo (2008) itemized several methods to be employed in teaching Basic science at the Upper Basic level, in the classroom to present scientific facts, information, principles, skills as well as concepts which include the following: demonstration method, lecture method, laboratory/experimental/activity method, discovery or inquiry method, project method and field trips method.

Atadoga and Onaolapo, (2008) is of the view that laboratory method are activity carried out by an individual or a group through the exercise and experimental approach for the purpose of making personal observation of processes, products or events. Laboratory exercises are activities carried out in other to provide practices in design, operating and interpreting experiment. Experiments are operations or procedures employed for the purpose of testing of hypothesis. Laboratory can be indoor or outdoor laboratory. Example of indoor laboratory is where students view microorganism with microscope and identify part of plants or animals cells while the teacher guides them. In outdoor laboratory, students can do activities like planting of beans after been guided by their teacher. The above activities can be effectively used to teach basic science but teachers must ensure that the procedure for the investigation should be very simple and clear. It should be based on the students' background and there availability of materials needed for the work. This method will encourage basic science teachers and lead them to better rotation of information and develop formidable attitudes of students towards science, also it will enable them to become familiar with such mental processes and ability for critical thinking.

Another innovation method of teaching Basic Science is discovery method. Dienye and Gbamanja (1990) states that it is a teaching strategy designed in such a way that students through their own mental processes to discover fact, concept and principle, Thus, student s then predict the result, make observation and relate the investigation to previous work done by other researchers. On the other hand inquiry method is a teaching approach whereby students are allowed to formulate the problem, state the purpose, predict the result, identify procedures and perform the investigation. Adedoyin (2000) sees inquiry as a method of teaching where the learner with minimum guidance from the teacher seeks to discover and create answers to a recognized problem through procedure of making a

diligent search. Inquiry is also a term used in science teaching, which refers to a way of questioning, seeking knowledge or information, finds a phenomenon that involves investigation, formulating hypothesis, gathering and interpreting data and arriving at a conclusion. Moreover, according to Abdullahi (1982) whether discovery or inquiry, it involves instructed exploration in which a student through his or her mental processes such as observing, measuring, classifying, analyzing, synthesizing and evaluating to draw general conclusion from data which are gathered. Discovery/inquiry method is student-centered and agrees with early psychology like Bruner (1966) who said that learning involves active processing of information that is organized and reconstructed in a unique way by each individual. In using this method the teacher should have the previous knowledge of what the child discovered and ensure that the size of the group is small. The method of discovery in teaching basic science increases the students intellectual ability and potentiality and help in memory processes and the students ability to organize and carry our investigation. It builds up confidence, motivation for further exploration and self-development among students. Project is another method of teaching in which teachers employ to teach science.

Project method is similar to laboratory method, Sola and Ojo (2007) opined that project method of teaching involves assigning a particular work to students to work on either in group or as individual and to complete it at his/her spare time and report back to the teacher as demanded. The project method provides an excellent opportunity for the complete act of thinking by the students. They further attributed that project method is a means of teaching the students self-discipline because he/she will define the problem, plan the work, find appropriate resources, carry out those plans and draw conclusion. It is meant to individualize instruction. This requires a bit of originality giving students free hand to look problems, which are of special interest to the finding solution to these

problem. The method provides for the needs of individual students or sometimes, small group or that those with special ability may have opportunities to be fulfilled. However, project method requires great deal of supervision and guidance from the teacher. It is also student-centered method.

Atadoga and Onaolapo (2008) is of the view that another method for teaching basic science is the field trip, this takes place outside the classroom like visit to the Airport, Yankari Game Reserve with the purpose of making relevant observation and guarding specific information of what has been taught in the classroom. The method offers students with the opportunity to be actively involved in specific processes such as observation, data collection, classification, making inference, studying relationship, manipulation of object etc. complete picture of concept been taught is gained or actualized using this method by the students. Field trip is believed to be an important part of an effective science instruction if well planned and plays the same role as laboratory experiment and demonstration because first hand experiences are gained in the process. Abdullahi (2006) stated that well-designed, planned and structured field trip could provide an effective instructional experience. By providing an alternative to the normal science classroom setting, it can promote motivation and achievement.

Adamu (2010) stated that Lecture / Chalk and talk method of teaching is the most popular methods of instruction commonly used for science teaching. This method is traditionally referred to as the didactic approach and is defined as teaching techniques in which one person usually the teacher present a spoken discuss on a particular subject. Idris (2014) says lecture method of teaching emphasizes talk and chalk in the teaching of science of subject. More than 80% of science information and principles are delivered via lecture method. According to Kelly (2009) the teacher does most of the activities in form of talking and writing on the board while the students listen. The effectiveness of this

method is that it requires clear and good command of language, good ability to write. It saves the teacher many challenges in the class. It saves time and energy. It is not expensive as only the chalkboard and chalks are required. It allows easy handling of large class without much stress and easy coverage of syllabus but does not promote meaningful learning. Idris (2014) says it is purely a teacher centered approach where students are not giving opportunity to ask question or give feedback to the teacher Moreover, Atadoga and Onaolapo (2008) said the that lecture method of teaching has the following disadvantage;

- The different ability groups present in any giving class are not taken care of
- It encourages only rote learning without necessarily aiding understanding.
- It is stressful for students sitting for a long period of time only listening and writing. It therefore leads to restlessness and disruption of normal class procedures.

However, on the bases of the short comings and weaknesses, effective teaching method which are student centered such as constructivist method of teaching like demonstration are used in teaching Basic Science. Adamu (2010) added that a cursory `look at the secondary schools in Nigeria has shown that many teachers in the system still rely much on the traditional "chalk and chalk" method of teaching rather than embracing the use of demonstration teaching method. Thus, Basic Science is an activity based course whose teaching and learning process requires method that concretize concept to the learners. It is on this background the research is going to identify and remediate errors committed in Basic Science among Upper Basic students using demonstration method of teaching.

Usman (2007) has observed that lecture method encourages rote learning without aiding understanding thereby resulting in poor performance. Furthermore survey studies in various states of the federation as reported by Akale (1992) and Akinmade as sited by Wakili (2014) showed that basic science teaching is being handled by incompetent

teachers who are faced with pedagogical difficulties as a result of their professional background. In the same vein Ajayi (2013) argued that the teaching of science in Nigerian secondary schools has suffered some setbacks because there are no adequate training programmes for the teachers. Ajayi (2013) further explained that science teachers need to develop their scientific attitudes and love of science. It is only when teachers acquire competence and confidence through training and re-training that they can translate same to science students who will in turn remove fear in their minds during their course of study.

2.2.3 The Objectives of Basic Science in the Nigerian Basic Education Program

Basic Science forms part of the curriculum of the 9-year basic education programme. It is the production of a re-alignment and re-structuring of the revised curricula for primary science and junior secondary school basic science. According to the 9- year basic education curriculum, the Federal Ministry of Education (FME) (2013), stated that the overall objectives of this curriculum run as follows:

i. Develop interest in science and technology
ii. Acquire basic knowledge and skills in science and technology
iii. Apply their scientific and technological knowledge and skills to meet societal needs.
iv. Take advantage of the numerous career opportunities offered by science and technology
v. Become prepared for further studies in science and technology

Bernard (2000) reported that basic science was established to aid understanding of the world. The United Nations Educational Scientific and Cultural Organization (UNESCO) (1971) sees basic science as an approach in which concepts and principles of nature are presented so as to express the fundamental unity of science. The idea of the Nigerian

Integrated Science Project (NISP) now basic science was borne by the Nigerian Teachers Association of Nigeria in the 1970s, which was an attempt to teach science as a unified whole. Basic science should enable students to be able to observe carefully and thoroughly, report completely and accurately, organize acquired information, generalize on the basis of acquired information, predict as a result of the generalization, design experiments and controls where necessary, check predictions, and use models to explain phenomena where appropriate. And continue the process of inquiry when new data does not conform to predictions.

Reflecting on the problems of teaching basic science, Bernard (2000) also suggested that we must pursue rigorously the issue of professionalism by involving high standard of initial training and a continuous updating through refresher courses, workshops, and subscription to journals, and through networking with others of the same specialization. He further described quality education as the key to sustainable development, and a major key to the attainment of Millennium Development Goals (MDGs). Nigeria just like other countries of the world is a partner in the attainment of these goals. Hence, one of the biggest challenges facing Nigeria at present is the provision of quality education for all the citizens.

The area in which the Nigerian government has persistently emphasized is the need for the provision of high quality education in Science, Technology, and Mathematics Education (STME) at the junior secondary level of education because the level could be seen as the foundation stage for the future learning of science and technology. According to Ibe, (2006), a strong background in STME is crucial for many careers and job opportunities in today's increasingly technological society. STME is expected to contribute immensely in the attainment of the Millennium Development Goals (MDGs) in the area of science and technology for a sustainable national development.

2.2.4 Resources for Teaching Science in Nigerian Basic Schools

At the upper basic science level (Junior Secondary School), three core subjects make up the STME. These subjects are Integrated Science, Introductory Technology and Mathematics. To ensure quality in the learning of these subjects, there is need for the use of adequate resources for their teaching and learning. Ibe (2008), Franzers, Okebukola and Jegede, (1992) explained that resources includes, vast ranges of human and non-human variables used to facilitate the effectiveness of the educational programmes. Okeke (2015) explained resource allocation as the provision of resources, utilization, and management. Part of resource allocation is the provision of experienced teachers, payment of teacher salaries, and provision of funds for laboratory, machines, equipments, books, and allocation of instructional hours to various subjects in the schools curricular. These resources are vital tools for efficient and effective delivery of education packages spelt out in the STME curricular.

In view of this, at the Upper Basic Science Education level, the students should be engaged in learning science as a composite discipline by working with hands and tools to design more advanced technological modules than at the lower basic science level, and in activities and analysis on issues surrounding environment and health. Systematic experimentation as a tool to discover/verify theoretical principles and working on locally significant projects involving science and technology should be an important part of the curriculum at the upper basic science level. Thus, this study assessed the Effects of the Computer-Assisted Instruction on the Acquisition of Process skills, Retention, and Performance in Upper Basic School Students in Kano metropolis, Nigeria.

2.2.5 Instructional Techniques for the Teaching of Science

There are various teaching techniques for imparting scientific knowledge to the learner. Bichi (2009) narrated that the teaching of science does not depend on teacher's

knowledge not of the method but his/her skills to use the appropriate method or a combination of two or more methods. He went further to say that no particular method is labeled good or bad, it all depends on how the teacher uses them. Datom (2015) explained that instructional techniques for the teaching of sciences include the lecture method of teaching, the activity method of teaching, and the Computer-Assisted-Instruction as another dimension of the activity based teaching strategy. Other examples of activity method of teaching includes, the demonstration method, inquiry based technique, problem solving method, cooperative learning strategy, and the technology - assisted instruction which entails the use of technological devices like computer and the like. Computer-Assisted Instruction (CAI) is comprised of techniques like the Computer Assisted Instruction (CAI), Information Communication Technology (ICT), Virtual Field Trip (VFT) Instructional Strategy, teaching with Interactive Multimedia Board (IMB).

Paul and Dantani (2012) reported that the teaching method adopted by a teacher may promote or hinder learning; it may either sharpen the students' ability or otherwise discourage initiatives and curiosity of the learners, thus, making self reliance and survival difficult. Paul and Dantani (2012) further explained that one of the oldest and most common ways of providing scientific information to students is through the lecture method. Nwago and Abu (2008) described lecture method as a teacher- centered method in which the teacher does the bulk of the talking as he presents large body of facts and principles to students whose roles are to be just passive learners. Abdullahi (2012) narrated that the conventional lecture method of teaching is not expensive since only the chalk and chalk board are required for this purpose. Garba (2012) observed that the conventional lecture method allows easy coverage of the syllabus but does not augur well for meaningful learning of science subjects. He added that the conventional lecture method can be boring and frustrating as students are made to sit for a long time writing

and listening. It also encourages rote learning without understanding. Kelly (2009) affirmed that lecture method can be a method that is used primarily to introduce students to new topics, and it is also a suitable method for summarizing ideas, showing relationships between theory and practice and emphasizing the main points in a lesson. Lippicottet (2009) explained that in a lecture method, theory is taught as an absolute knowledge which serves as a pupil centered activity for developing scientific reasoning. Hall (2005) asserted that lecture method involves verbal presentation of facts, ideas, and concepts and does not stimulate students' innovation, development of scientific attitudes and acquisition of process skills as well as make students to become bored and hence easily distracted.

Garba (2012) described the lecture method of teaching as a traditional method of imparting knowledge to the learner. It allows the teacher to deliver a large amount of information within a short time. Preparation is usually done by the teacher alone and can be repeated on a routine basis for each new group of learners. It is also used to introduce students to a new subject and serve as a valuable method of summarizing ideas, showing relationships between theory and practice and re- emphasizing the main points. The instructor is required to read and present all the necessary illustrations or demonstrations. Obeka (2009) described lecture method as a teacher centered method. He went further to say that the lecture method enhances acquisition of subject matter predominantly under memorization and close supervision of the students by the teacher. James (2000), Bichi (2002) and Usman (2008) reported that for quite a long time, the lecture method has served as one of the science teaching strategies that encourages rote learning and regurgitation of information without necessarily facilitating understanding. Therefore, this does not enhance performance in sciences. Although this method has some disadvantages, teachers often use it as a teaching strategy. Suwaid, (2013) suggested that in an ideal

learning environment students do more than listen, they read, write, discuss, and involve themselves in reflective activities, however, there is a strong need to try some activity based teaching strategies like the Technology- Assisted Instruction (TAI) in line with good global trend.

Another type of instructional technique is the activity based teaching strategy. The activity based teaching strategy is a teaching strategy that makes students to participate actively in the teaching and learning process. It is a learning process that takes place through constructive activities. Alemu (2010) reported that active involvement of students in teaching and learning process either in the classroom or outside the classroom enables them to develop critical thinking skills. He went further to say that in active learning environment lecturers facilitate rather than dictate the students learning, and students construct their own knowledge through a series of activities. Suwaid, (2013) explained that the active learning process is a transformation from the conventional lecture method that is usually teacher centered to a new student- centered teaching practice and the use of strategies that will enhance their experience. She further narrated that the activity method of teaching is comprised of several teaching methods like the demonstration method, project method, inquiry method, guided discovery method, problem solving method, Computer- Assisted Instruction and the like.

Demonstration method of teaching is a teaching technique which can be carried out jointly by the teacher and the students, by the teacher alone or by the students alone, either individually or in group. Bichi (2009) explained that demonstration entails doing something or performing an activity in the presence of other people with a view of either showing them clearly how to do the task themselves or illustrate a certain principle or concept. Questions are usually entertained after the demonstration exercise. In using a demonstration method as an instructional technique, the science teacher may have to

assume the role of a sole actor throughout the lesson. The reason for embarking on demonstration in a science class may be to show methods and techniques, to display objects, materials and specimens, to illustrate a scientific fact, concept, or principle, other reasons that can make a teacher or an instructor to embark on a demonstration technique as reported by Bajah (1983) are to solve a problem, to stimulate interest, to find information as well as evaluate pupils performance. Demonstration teaching technique can be used in teaching science subjects, arts, commercial subjects and religious studies.

Inquiry method of teaching is defined as a method of teaching by which a learner studies using the scientific processes like observing, comparing, classifying, experimenting, communicating, inferring etc inquiry learning is based on the constructivist approach in which students have ownership of their own learning. According to the instructional theorist inquiry method of teaching and learning is defined as a technique by which the learner studies scientific phenomenon using the correct scientific approach like observing comparing classifying experimenting communicating and inferring etc. Odunbunmi (2006) defined inquiry method as a process of answering questions and solving problems based on logical examination of facts and observation. It often begins by providing students with content related problems that will serve as a focus for class research activities. In working with problems students generate hypotheses, gather data relevant to the hypotheses and evaluate the data to arrive at a conclusion. Students use inquiry process to develop explanations from what they observed by integrating what they already know with what they have learned. Students as well learn discrete science concepts and skills, and how to solve problems using practical approach. Sharon (2009) explained that in addition to learning content associated with problems during inquiry, students also learn strategies for solving future problems, hence the need for science teachers to incorporate the inquiry teaching strategy into their teaching so as to enhance

students' performance, aid retention as well as motivate students to acquire the science process skills.

Sola, and Ojo (2007) reported that inquiry based classrooms should include, a multifaceted activity that involves making observation, posing questions, examining books, and other sources of information to see what is already known, then plan investigations, review what is already known in the light of experimental evidences obtained, using tools to gather, analyze, and interpret data, proposing answers, explanations, predictions and communication of results. Inquiry allows students to take on the roles of scientist as they use inquiry process to develop explanations from their observation by integrating what they already know to what they have newly learned. Students learn discrete science concepts and skills and how to solve problems using practical approaches. Cooperating inquiry approach into the science classrooms will help to empower students and make them to play an active role in the learning process rather than the passive role that is commonly seen in the traditional classrooms.

Bichi (2002) explained that problem solving instructional strategy is another type of activity based instruction. He went further to say that it is a teaching strategy that gives students the ability to identify and solve problems by following the systematic and appropriate scientific skills. In another assertion Bichi (2009) also opined that problem teaching approach of teaching is to be interesting, challenging, and motivating, therefore this mode of learning help to expose students to certain scientific skills like description, planning, implementation, and checking the result of what has been implemented. Oyedokun (1998) also reported that the problem solving technique also provides opportunity for the students to use their newly acquired skills and knowledge in a meaningful way. Oyedokun (1998) added that the problem teaching strategy enables the learners to take ownership of the lesson and tasks by being creative and inventive as it is a

form of active learning and discovery learning which allow cross curricular activity. It provides relevance to real life contexts. Problem solving method helps in enhancing the level of communication and promotes interpersonal relationship among learners and it encourages decision making in sciences and many social sciences. According to Corder, (2001) there are numerous strategies that can be employed in solving a given problem like trial and error, mental application, working downward and the like. Bichi (2002) discovered that effective learning takes place when cooperative learning is being adopted as it provides more room for learners to help one another in a conducive learning atmosphere.

2.3 Use of Computer Assisted Instruction (CAI) in the teaching of Science

Karl (2001) defined the term technology as material and immaterial entities created by the application of mental and physical efforts in order to achieve some values. In this usage technology refers to tools and machines that may be used to solve real-world problems. It is a far reaching term that may include simple tools, such as a crowbar or wooden spoon, or more complex machines such as a space station, a computer, a projector and the like. Virtual technology such as computer soft ware fall under this definition of technology

In line with the definition given, by Walker, Voce, and Ahmad, (2012) described Computer-Assisted Instruction (CAI) as the application of Computer Technology in the process of teaching and learning. Roberts (2003) reported that Computer Assisted Instruction is an online facility or system that directly supports teaching and learning. Bling, Munro and Eynon (2008) narrated that what is more commonly found in practice is that computer is used to replicate or supplement traditional teaching technique. Cuban (2001) observed that an overwhelming majority of teachers employ computers to sustain existing patterns of teaching rather than to innovate. He went further to say that only a

small percentage of teachers use the new technologies as a form of student centered approach for the teaching of sciences.

Scholars like Belal (2011); Dahlgren (2005); Marton and Saljo (2005) are of the opinion that computer mediated interaction provides a highly structured context which successfully engage students and support their performance. In this respect, this study intends to test the effect of Computer Assisted Instruction on the Acquisition of Process skills, Retention and Performance among Basic Science Students in Kano, Nigeria.

Belal, (2011) narrated that success or effectiveness of Computer-Assisted Instruction (CAI) will always depend on the alignment of education and technology (informatics) components. Ringstaff and Kelly (2002) proposed that the use of Computer-Assisted Instruction (CAI) can foster more of student-centered learning and can help to extend the period of interaction from in class to out of class settings; thus the place of interaction is no longer limited to the classroom. An effective learning would begin from reflection and conceptualization to action followed by enhanced experience. Mayer, (2003) also explained that since most scientific concepts are abstract in nature, and scientific methods are complex, then specially designed technologies like the computer for specific instructional purposes would support students to learn related scientific concepts better, as well as help students to conduct simulated- based experiments.

The adoption of Computer - Assisted Instruction (CAI) has numerous advantages in the teaching and learning process as it offers exciting approaches to teaching and learning. Hamza, (2006) explained that the use of Computer - Assisted Instruction (CAI) has caught the attention of many educators and researchers, because computer based instructional applications are considered as effective alternatives to traditional teaching methods. Danjuma (2004) opined that the use of CAI creates and sustains students' attention and curiosity in the learning process. In addition, he went further to say that the

use of computers in education has provided most of the knowledge that is related to natural phenomenon in the computer environment. Liao, (2007) reported that simulation varieties provide an excellent means of developing science process skills and higher order thinking skills as a part of students' interaction with soft ware. Hence in this research work, the researcher intends to assess the effect of Computer-Assisted-Instruction on Process skills Acquisition, Retention and Performance in science teaching and learning through the use of a personalize computer soft ware package to teach pollution concepts among Upper Basic Science Students in Kano.

Computer-Assisted Instruction (CAI) is a terminology that is often used in an educational setting to describe the process of teaching and learning through the use of computers. CAI is effective in conveying a vast amount of information in a very short period of time. It is seen by many as a powerful method of reinforcing concepts and topics that are introduced for the first time. It is a method that disregards rote learning and argues that learning should be based on computer assisted instruction. Many instructors rely on lectures and text memorization. Often they rely on "telling" and what is told does not translate into usable skills. The computer assisted instruction helps the learner to learn by doing. Hamza, (2006) pointed out that technology tools like computers enable students to get exposed to new and innovative techniques and bring about an effective presentation through the powerful tools of e-learning and e-blackboards. The development of computer assisted instruction (CAI) by programmers can also serve as a form of instruction that can assist to re- teach or re-instruct and can take care of several students.

The most common use of computer assisted instruction is the use of computer for simulation and retrieval applications which according to Liao (2007) provides an excellent means of developing science process skills and higher order thinking skills as part of students' interaction with soft ware. Simulation enables teachers to show

experiments which would otherwise not be possible in a usual classroom setting due to the lack of appropriate teaching tools. Mayer (2002) observed that an instructional delivery involving the use of VCD/DVD or power point or 16mm film is a multimedia presentation. CAI is run either straight from CD or floppy disc drive or over a local network as such the constraints of the internet like slow download times for multimedia materials may not apply. Many people especially adults learn best in social settings, as it promotes knowledge exchange and resolving the resulting cognitive conflict.

In most Nigerian schools where teaching materials and apparatus are not available, the dominant method of teaching large class is through the use of lecture method. In view of that, the use of computer in the process of teaching and learning stands a very good chance of yielding better results. Mayer (2002) went on to say that still pictures, text, graphics, motion pictures, background sounds as well as some narrations are synchronized or combined at the same time in order to enhance learners understanding of a concept. Kaye, (2002) explained that technologies which support such interactions are likely to improve learning, for instance research on the use of video in lessons has shown an increased retention and better results. Virtual classroom also provides the opportunity for students to receive direct instruction from a qualified teacher in an interactive environment. CAI is used in this study to determine its effects on Process skill Acquisition, Retention and Performance in Science learning among Upper Basic Science Students in Kano, Nigeria.

2.3.1 Information Communication Technology

Information Communication Technology refers to any electronic means of capturing, processing, storing, and dissemination of information. It is a combination of Information Technology (IT) and Communication Technology (CT). Obayelu and Ogunlade (2006) refers to Information Technology (IT) as the packaging and processing of information,

while Communication Technology (CT) involves the interaction, exchange, and linkage of information and data base between users through networking. Hamza (2006) also defined ICT as integration between computer and all sorts of electronic communication devices in order to enhance quicker access and dissemination of information.

Advances in information and communication technologies have brought about exciting opportunities for fundamental changes in education. For instance, Allen and Seaman (2006) reported that by creating vivid, playful, interactive learning environments with the support of multimedia presentations; an easy platform of learning that can support knowledge dissemination is provided. Powers and Mitchell (2007) suggested that the adoption of online exercises and virtual discussions will provide a greater students control of the learning situation, particularly the internet. They further narrated that in a longitudinal field study of knowledge category on learning effectiveness and satisfaction "learner ability" refers to the degree to which a student considers the course materials delivered through Computer-Assisted Instruction (CAI) or conventional learning easy to learn. The study further reported an important positive effect of collaborative learning on people's learning experience.

In a study conducted by Mohammed (2011) on the availability and use of ICT in public secondary schools in Kwara State, Nigeria. The study revealed that the use of ICT in schools help in making work faster and easier as well as improve the quality of services in schools and reduces administrative work load, and at the same time motivates students to work harder and facilitates access to information. This is in line with Hameed (2006) who asserted that the use of computer can enhance educational efficiency and serve in administrative functions.

Aragon, Johnson, and Sheik (2002) also in a study conducted on students' performance in sciences reported that it was discovered that students learn effectively in an online

presentation more than in a conventional classroom setting regardless of the differences in learning style, preference, motivation, task engagement or cognitive control. Gulz (2005) in the analysis of technology-assisted learning satisfaction using structural equation modeling suggested that educators and web based course designers should make learning materials easy to comprehend. This will help to encourage information exchange and social interaction among peers in such a way that learning can be supported in an online forum or virtual discussion.

Eileen and Tim as sited by Suwaid (2013) asserted that children who learn informally through the use of technology devices do not seem to show any difference in terms of school achievement. Nsofor and Ala (2013) explained that information communication technology (ICT), is a learning intervention that can either be used to enhance practical investigation or as a virtual alternative to real practical work where simulation supports exploration of the investigation model through a computerized representation of the phenomena under study. They also pointed out that modern information and communication technology is very important in teaching and learning. For example, the use of computers, television, radio, internet etc brings about easy access to information, making learning more flexible and interesting. E-learning facilitates distance learning, promotes teacher productivity, improves institutional management and expands time for learning beyond school period.

Globalization in terms of Information Communication Technology (ICT) has touched and changed most aspects of human lives and development in both developed and under developed nations throughout the world. Hamza (2007) asserted that the impact of information and communication technology has been felt in the home, in the school, in the area of training, defense and security, finance and commerce, in the manufacturing industries, and in the offices. Generally ICT works all around us even when we are not

aware of its presence. Information Communication Technology (ICT) has revolutionalized the human ways of life. All over the world many human activities have been taken over by ICT, for instance in the field of modern medicine telemedicine has brought about tremendous improvement all over the world. In education computer assisted Instruction (CAI) covers a wide range of computer based packages that aim to provide interactive instruction usually in a specific subject area.

ICT is an acronym that stands for "Information and Communication Technology". It covers a wide range of products that will store, retrieve, manipulate, transmit or receive information electronically in a digital form. In line with this research topic the use of ICT is expected to enhance the acquisition of science process skills, performance and retention among Basic level Education Students. In several other studies like Shaheed (2007), Jason (2008), Shaik (2009), Yusuf and Afolabi, (2010) reported that ICT helps to improve the quality of learning and educational outcomes. Some other surveys like Khan and Shah (2004), Amjad (2006), Hameed (2006), Igball and Ahmed (2010), also argued that in order to be successful, a country should be implementing effective and robust Information and Communication Technology (ICT) policies. Barak and Doyi (2004) reported that Information Communication Technology (ICT) is an effective tool in teaching and learning when used by students to interface with pieces of scientific equipments so that measurements can be made and data logged for later use. They further narrated that the central features of practical activity in science has always been observation and measurement. Often students are required to make predictions about relationships between variables and quantify relationships. Graphs and spread sheets are particularly useful for such data displays and presentations. Students can as well use spreadsheets to tabulate and calculate results of experiments for individual or group work. With all of the

above task or activities in ICT students are therefore exposed to the constant usage or practice of the various components of the science process skills.

2.3.2 Virtual Field Trip Instructional Strategy

Virtual Field Trip was defined by Pace and Tesi (2004) as the use of electronic technology to deliver education and training applications, monitor learner performance and report learner progress. They stated that Virtual Field Trip refers to the use of networked information communication technology to leverage the core processes of education. They opined that Virtual Field Trip as the delivery of content through an electronic media; it includes the internet, intranets, satellite broadcast, audio/video tape, interactive TV and CD –ROM. Cox and Su (2004) defined Virtual Field Trip (VFT) as a technology- based experience that allows students to take an educational journey without leaving the classroom. As such, multimedia presentations bring the sights, sounds and descriptions of distant places to learners.

Cox and Su (2004) went further to say that virtual trips vary in complexity; they range from a single power point or video presentation to a multifaceted virtual experience integrating photos, videos, text, audio, video conferencing and internet resources. The VFT learning experience does not replace reality but serves to expose children to experiences they typically cannot have. Virtual field trips involve the use of video conferencing and audio conferencing technologies to permit students in one location to virtually visit and learn about people in other places. It serves as an opportunity to see and experience the world without even leaving the classroom. Virtual Field Trip (VFT) is cost effective to schools as it eliminates the costs of renting, transportation, additional insurance coverage and the like. The purpose of this study therefore is to determine if the use of Technology- Assisted Instruction (TAI) like virtual field trip will enhance student's performance and aid in the acquisition of science process skills in science learning.

2.3.3 Multimedia Teaching Strategy

Other aspects of Computer-Assisted Instruction (CAI) include the use of multimedia. Multimedia denotes the use of two or more Medias in teaching and learning activity. It is an extremely wide area that includes the fields of informatics, telecommunications, audio visual production sector, cinema, and digital media. Muoneme (2014) explained that "interactive multimedia" is a term that is used to describe scientific and creative research fields within multimedia which supports expression or communication through multiple media with the ability to influence and alter their contents and context. Mathew as sited by Muoneme (2013) defined interactive multimedia as the description of the combination of technology and multimedia content for the development of interdisciplinary systems employed in a wide array of applications including research, education and interactive art. The creative and communication aspect offered by interactive multimedia, presents multifaceted complexities as the development of real life applications is viewed from multiple ultra user perspective.

Interactive Multimedia Board as a form of multimedia teaching strategy can be relevant in the teaching and learning of various school subjects especially the sciences. Mayer (2003) noted that instructional delivery through the use of VCD/DVD or power point presentation are all examples of multimedia presentations, in that still pictures, text, graphics, motion pictures, background sounds as well as some narrations are synchronized at the same time in order to facilitate learning. Mayer (2003) also suggested that the use of interactive multimedia board involves the coordination of simultaneous processes to complete a task, be it a task involving film production and utilization, where images and sounds are synchronized simultaneously in the presentation of information to target audience. Interactive Multimedia Board (IMB) utilizes video and audio in a synchronized manner.

Mayer (2002) explained that the use of interactive multimedia board in instruction reduces learning time, cost, and creates more room for instructional consistency and learning mastery. It also increases retention, safety, motivation and access to new knowledge. There is no restriction in terms of when the instructor or teacher is available. He further opined that when interactive multimedia board is being used, learners enjoy interactive learning due to its efficiency, effectiveness and flexibility. IMB facilitates communication and appeals to sense of sight and hearing at the same time. It also provides concrete basis for understanding abstract and difficult concepts thereby making learning more meaningful and permanent.

Battista, (2009) explained that interactive multimedia equipments and programs are of a variety of kinds and are constantly changing depending on the work place and the type of task to be accomplished. It may include hard ware and soft ware, personal computers and lap tops, soft ware programs like power point, televisions, videos, microphones/ amplifiers, compact discs, DVDs, projectors, CD burners, scanners, digital cameras etc. According to Battista, (2009) the teacher is expected to use different techniques, methods, and media to facilitate learning in or outside the classroom. In this regard this study intends to assess the effect of TAI on performance, retention and acquisition of science process skills in science learning among junior secondary schools in Kano Metropolis.

Sentini (2004) was of the opinion that computer based instruction Vis- a- Vis the traditional lecture method makes teaching techniques far more effective. Multi-media contribute in a number of ways in a learning environment. For example it assists the teacher in his presentation as well as motivates students to take active part in the overall learning process. Akpinar (2005) reported that computer based multimedia instruction is very much effective in helping the students to develop creativity, develop the problem solving skills, and help to develop self-reliance in students. Akpinar (2005) further

explained that Computer based multimedia provides drawings, graphics, animation, motion pictures and the like. Similarly Senteni (2004) and Liao (2007) said that computer based media are some of the reasons behind the development of positive attitude, improved performance, and motivation, which is obviously shown by students exposed to computer based instructional multimedia. According to Smeet and Moij, (2001) the use of computer assisted instruction is supported mostly by the behavioral view of learning based on the principles and practice of reinforcement.

Since there are various arguments to whether the use of computer assisted instruction is likely to enhance the teaching and learning of sciences, then the researcher in this study intends to use a personalized computer soft ware package to teach pollution concepts to upper basic science students in Kano. The use of which may assist the researcher to determine the effect of the use of Computer-Assisted Instruction on the acquisition of Science Process Skills Retention and Performance among Basic Science Students.

2.4 Performance in Basic Science among Junior Secondary School Students

Performance refers to the accomplishment of a given task measured against preset known standards of accuracy, completeness, cost, and speed (Sati, 2014). In the contrast, performance is deemed to be the fulfillment of an obligation, in a manner that releases the performer from all liabilities under the contract. However in an educational setting performance has been defined in so many ways by different educators. For example, Deary, Whiteman, Starr, Whalley, and Fox (2004) defined performance as a complex students' behavior that underlies several abilities like memory, previous knowledge, aptitude, as well as psychological factors such as motivation, interest, temperaments, or emotions. The extent to which a student, a teacher, or an institution has achieved an educational goal can also be termed as performance. In line with this research, performance refers to the degree of success in terms of learning outcome either through

the use of Computer-Assisted Instruction (CAI) or through the conventional lecture method. Several studies such as Okebukola (2002), Danjuma (2005), and Deborux (2007) were conducted to test the effect of the lecture teaching methods on students' Performance and Process skills Acquisition in Basic Science. The studies revealed poor learning outcome. Nwagbo (2006) also expressed similar view, that is to say poor performance has been attributed to poor quality of teaching strategies that were being employed.

According to Danjuma (2005), Computer Assisted Instruction (CAI) can help to enhance student's performance. Adamu (2008) narrated that the causes of poor performance are diverse and cannot be associated with a single factor. Other factors may be attributed to teacher student interaction. Yoloye (2009) suggested that a good performance in any form of activity based upon interpretation and application of the learned material. Clark (2006) in his own opinion suggested that for a good performance, being smart is more important than using better organization and application of good study habit. He also revealed that the determinants of good performance in basic science are of different kinds and are widely studied: They include variables like student's socio economic background, school input and inborn factors. Socio-economic factor according to Cheecci and Peragine (2005) is measured by the educational level of the students' parents, and has a positive impact on the school performance of the students. Several studies were conducted to investigate the relative effects of instructional methods on students' performance. For instance, Downie and Maden, (2009) investigated the effects of laboratory approach and lecture method on the performance of integrated science students, and found significant difference in favour of those taught using laboratory method.

Martins (2004) compared the effects of lecture method and inquiry method on the performance of Nigerian Integrated Science Students, and concluded that inquiry method

yielded greater performance than lecture method. Oyedokun (1998) investigated the effect of conceptual change teaching strategy and traditional teaching strategy on student's performance and retention in Biology concepts, and found that students taught using conceptual change teaching strategy achieved better than their counterparts who were exposed to traditional method of teaching. Also Adamu (2008) investigated on the relative effectiveness of collaborative effect of concept mapping and lecture method on the performance of mixed ability biology class. The result showed a significant difference in performance in favor of concept mapping.

Abu (2008) investigated on the effects of learning activity package (LAP) and expository instructional method on the performance of Upper Basic Science Students. The result showed a significant difference in performance in favour of the academic Learning Activity Package. Emeka and Odetoyinbo (2003) studied the effect of teacher student interaction on performance, among integrated science students of different class level, and different ability groups and found that students in large class exposed to high level of teacher student verbal interactions, performed significantly higher than students in small group and medium level of interaction. Students in medium class exposed to high level of teacher student verbal interaction performed significantly higher than those taught with other levels. Students in small class exposed to high level of teacher student verbal interaction performed significantly better than those taught with other levels. In this study therefore the effect of Computer-Assisted Instruction (CAI) on the acquisition of process skills, retention and performance, among basic science students in Kano will be investigated in order to determine whether or not the teaching strategy has any positive effect.

Generally, some research evidences showed that there has been consistent poor performance in basic science in Nigerian basic schools due to various reasons or another.

For example, a study conducted by Bala (2010) on the assessment of the impact of the use of mother tongue on the performance and interest of primary school pupils in basic science in Kano metropolis revealed that the students who were taught using mother tongue as a means of communicating science concepts performed significantly better ($P < 0.05$) than those who were taught the same science concepts using English language as a means of communication. It was also revealed that when science concepts were taught using mother tongue as the media of communication the students showed more interest. ($P< 0.05$) in terms of participation. The use of mother tongue therefore has significantly higher effect than the use of the English language. The above findings indicated that the use of Computer- Assisted Instruction (CAI) may be of immense benefit in ameliorating students' performance and aiding in the acquisition of the science process skills among basic science students, as the use of "hands on minds on" yields better result in science learning.

Another study conducted by Datom (2015) on the effect of class size on students academic achievement in Basic Science in Zaria Educational Zone, Kaduna State, Nigeria, showed that in the comparison of the academic performances between experimental group and control group, it was discovered that the subjects in the experimental groups showed better performance over their counterparts in the control group. Therefore, this indicates that instruction is more effective in small groups than in large groups. This therefore is in line with what Computer- Assisted Instruction (CAI) has to offer, as students are allowed to work either independently or in small groups. Hence, it is envisage that this study will hopefully help to further determine if the use of CAI in science learning can enhance the acquisition of process skills, retention and performance in basic science.

2.5 Science Process Skills and Science Learning

Science being a study of nature deals with the search for truth and beliefs in rational answers to questions about the nature of life and the universe. Bala (2010) explained that in pursuing those answers scientist try to adhere to particular rules and habits of thoughts that have proved reliable in the painstaking process of building up dependable pictures of the world. Training on the acquisition and application of science process skills is an important component of science education, for they are the main tools for the search and acquisition of scientific knowledge.

Mifflin (2002) defined science process skills as tools for students' use in investigating the world around them, and for the construction of science concepts. According to Woolnough (2005), it was explained that scientific processes can be split into various processes, namely observation, communication, measuring, comparing, contrasting, organizing, classifying, analyzing, Inferring, hypothesizing, and predicting. Olajide (2014) argued that the most distinguishing characteristic of science is the way it finds the scientific knowledge (method of exploring the universe). She further described process skill as an activity that takes place in the mind of men as a result of certain intellectual scientific processes which are the means by which one can examine the unknown, explore, and investigate through experimentation and analysis of data. Other scientists like Gagne (1977), described these processes as intellectual skills which do not only help the child in understanding the school subjects but in his approach to everyday life. That is to say, process skills are common to systematic thoughts in all formal, informal and common sense reasoning. They are assumed to be general cognitive skills which man routinely employs throughout life without any need for formal instruction.

From another perspective, Shepardson (2000) investigated on students' problem solving phase, students' interaction and thinking skills as a consequence of which he came up

with the following steps or phases, i.e. problem finding and re-defining phase, research designing phase, data collection phase, data analysis phase and evaluation phase. UNESCO (1992) in its own attempt summarized process skills as a series of activities which attempts to explain and re-define an existing situation; namely observation, questions, hypothesis, prediction, finding patterns and relationships, communicating effectively, designing and making, devising and planning, investigating, manipulating materials and equipments effectively, measuring and calculating, then finally computing result in an effective way. The Inner London Education Authority (ILEA) (1987) also draws attention to the following Science Process Skills, i.e. applying, interpreting, classifying, investigating, evaluating, observing, predicting, hypothesizing, raising questions, and inferring.

In another dimension Gilbert (2011) classified the science process skills into basic process skills and Integrated Process skills. He went further to say that in a guided inquiry, students examine a new phenomena often in the form of a problem before the teacher goes on to discuss, design, interpreted the result and finally uncover the underlying concept.

The Basic Process Skills: Mari (1994) explained that the basic process skills are six in number and include, observation, measuring, inferring, classifying, predicting, and communicating. Mari (1994) went further to say that observation is the most fundamental of all the science process skills.

Observation: Observation is conducted through the use of any one or a combination of the five senses; i.e. the sense of sight, sense of hearing, sense of touch, sense of taste, and smell. Observation leads to the identification of problems that calls for investigation. Skilled observers seem to proceed from general perception of a system to more specific ones. Therefore in a nut shell observation can be termed as an objective process of

gathering data through the use of one's senses applied in an analytical way. It is essential for the science learner to understand the concept of observation as a means of generating information from the environment through the use of the five senses and appropriate sense aids and extenders. Observation deals with the physical outlook of the subject under investigation and leads to a theoretical generalization which is then tested and perhaps extended by further observation or experimentation.

Measurement: The second basic science process skill is measurement. Measurement is a science process skill that is used in presenting or providing information about a particular subject in numerical form. In another dimension it can be considered as a form of observation that is made more specific by comparing some attributes of a system to a standard of reference.

Classification: Another important skill among the Basic Science Process Skills is the skill of classification. The term classification is termed as the process of grouping of objects for the purpose of identification. Classification is based on the identification of certain observable traits. That is to say objects that share the same characteristic should belong to the same group. Classification is an important scientific process in sciences and the nature of the skills of classification defends on the ability to identify traits, ability to select traits that are similar in their deeper meaning, and finally classify them on the basis of a set criteria.

Inference: The next process is the process of inference which is an inventive process in which an assumption is made to explain an observed event. In other words it is what one decides about an observation, or an attempt to explain or interpreted observation based on some evidences Inference precedes theory in any scientific finding and the nature of the skill of inference is to be able to identify a trend in a body of data and then project that trend in a way that can be tested.

Prediction: Prediction is also a basic process skill. Literally the term prediction is used to describe an educated guess about an event. Therefore as a science process skill it deals with predicting events based upon a body of information, and it should always be a data based prediction not a guess and must also be testable. In essence predictions can be accepted or rejected based upon observed criteria. If they are not testable then they are not predictions. Scientific process therefore depends on this kind of repeated interactions between practice and theory.

Communication: Communication is an important component of the basic science process skills and it is considered as a group of skills all of which represent some form of systematic reporting of data. For example data display, charts, and graphs. The purpose of communication skill is to represent information in such a way that the maximum amount of data can be reviewed with an eye towards discovering inherent patterns of association. The inherent nature of communication includes the ability to see and consequently represent information as the interplay among influencing variables. For the purpose of this research study, the researcher intends to test the effect of process skills acquisition on the basic process skills that are outlined above.

The Integrated Process Skills: Anderson, (1970) reported that the integrated process skills are eleven in number and they include formulating hypothesis, identifying variables, defining variables operationally, describing relationships between variables, designing investigations, experimenting, acquiring data, organizing data into tables and graphs, analyzing investigations and their data, understanding cause and effect relationship, and formulating models.

Data Interpretation: One of the most important components of the integrated process skills is the skill of Data Interpretation. This is termed as the ability to recognize patterns and association between bodies of data, there is a direct contribution of communication

process to interpreting data. Interpretation usually requires creative thinking that results in the invention of conceptual umbrellas that can encompass the data.

Hypothesis: Hypothesis as a science process skill is an intrinsic and creative mental process. The nature of the skill of hypothesizing is to recognize that objectively gathered observations are justified into an explanation as a result of having an operational cosmology or world view. A good hypothesizer recognizes that explanations are inventions rather than discoveries so therefore they are subject to acceptance or rejection based upon established facts. Beyond this no one is really sure how hypothesis is generated, and no one really knows what goes on in the mind that results in a hypothesis. However it seems reasonable to suspect that information, perceptions, and ideas are being combined over and over again until a particular combination seems to make sense.

Controlling Variables: In conducting an experimental research, a scientist has to be able to control variables, therefore controlling variable is considered as one of the integrated science process skills. This process is a kind of group process because one may engage in several different behaviors in an attempt to control variables. This process is an attempt to achieve a circumstance or condition in which the impact of one variable is clearly exposed. The use of experimental and control circumstances, standardizing procedures and repeated measures are only a few of the ways in which variables might be controlled. In order to understand the nature of this skill one requires an analytical thinking in which the system under study can be reduced to a set of interacting components. The next step is to establish some circumstances that allow the scientist to observe one component in isolation.

Experimentation: Experimentation is one of the most important integrated science processes as it provides a systematic approach to solving a problem. Usually experimentation is synonymous with all the scientific methods because each step emerges

from the previous one. The purpose of the process is to judge the extent to which a hypothesis might be true and to set terms of probabilities of truth rather than absolute correctness. As a term experimentation is frequently used in a much broader way than described, but strictly speaking experimentation should be reserved for the process of evaluating hypotheses.

Several other scientists like Anderson (1970), Wilson (1974), and Rachelson (1977) attempt to describe process skills in the form of models. Gilbert (2003) defined the term model as a system of objects, symbols and relationships representing another system. A model may be concrete or abstract, but they all share certain common characteristics, for example they all function through analogy, that is to say they all have the same relationship as their counter parts in another set.

2.5.1 Models of Process Skills

James (2000) explained that a scientific model is the most basic element of scientific method. Models are designed in order to provide an accurate representation of the knowledge needed to solve a problem or to make the process of understanding easier. Therefore scientist like Rachelson (1997), Anderson (1970), Wilson (1974), and the UNESCO (1992) attempted to describe process skills in the form of models, as shown in Fig: 2.1, 2.2, 2.3, 2.4, and 2.5 respectively.

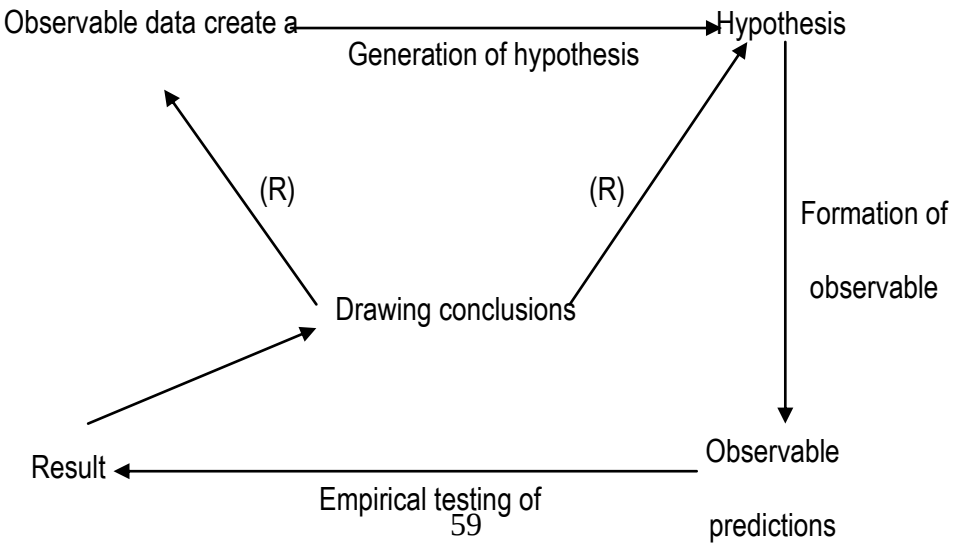


Fig 2.1: Process of Scientific Inquiry
Source: Rachelson (1997)

Figure 2.1 show the model of process skills designed by Rachelson (1997) which illustrates the relationship between testing and generating a hypothesis. It presents scientific inquiry as a self correcting revisionary system. The revisionary element is critical as it is the unique characteristic of scientific inquiries. Rachelsons' model of process skills attempts to explain how the basic process skills can be utilized in finding solution to an observable problem, by first generating a hypothesis, making predictions, testing the predictions using empirical control, finding results and then drawing conclusions. However the model has shown that the conclusions may be subjected to discussions that may further come up with another problem that may require further experimentations. In the context of this study the researcher intends to examine if the use of computer assisted instruction can assist the learner to acquire the basic process skills enhances the level of retention and improves performance among basic science students. The second model is a model of process skill by Anderson. The illustration for the model is shown in Fig 2.2

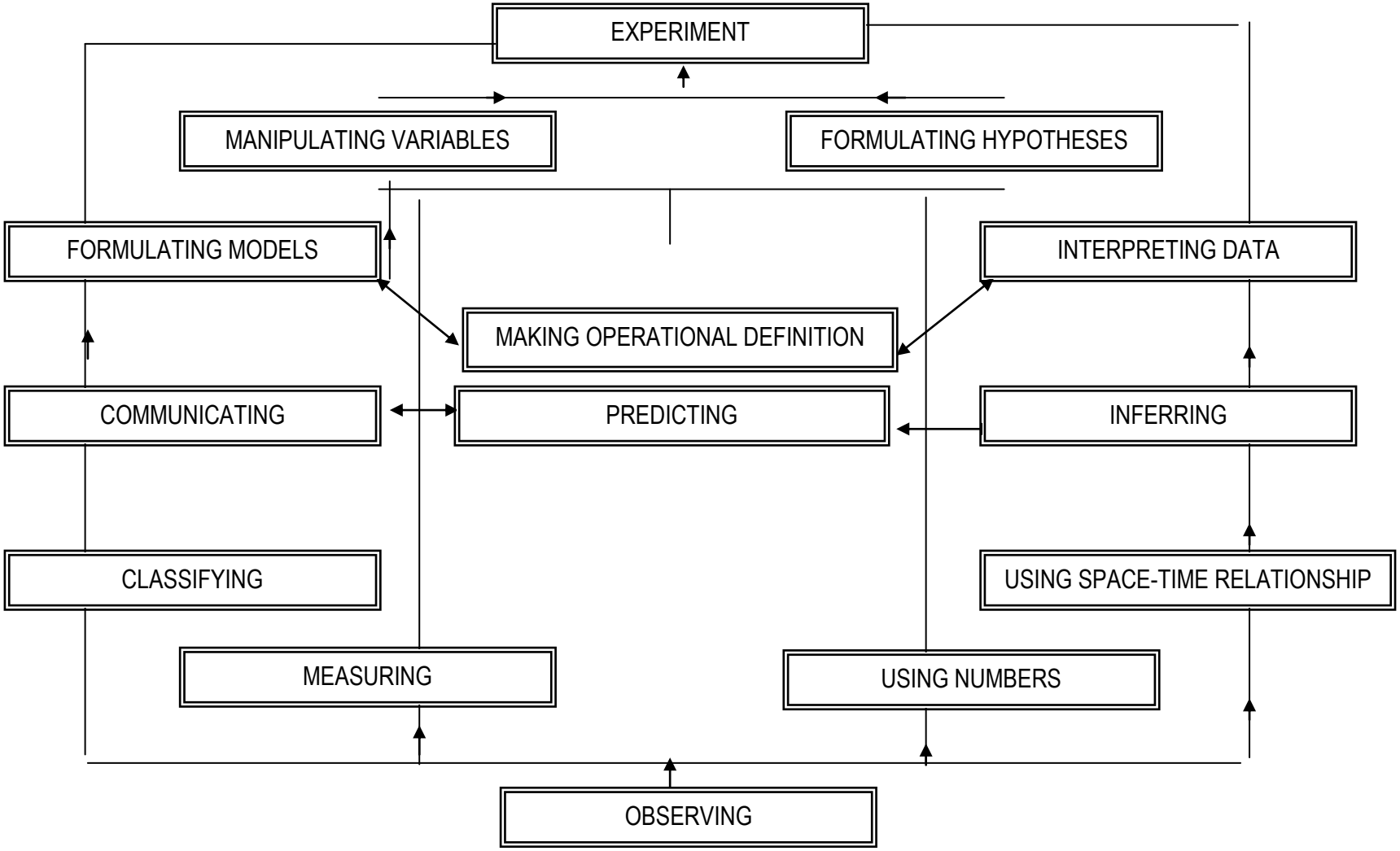


Fig. 2.2: **A Model of Process Skill by Anderson**
Source: Anderson (1970)

Figure 2.2 a model of process skill by Anderson (1970) tried to show the relationship between the basic process skills and the intergraded process skills. The design indicated that all scientific investigations have to commence with the basic skills of observing, measuring, classifying, communicating, and inferring and ultimately lead to the integrated science processes of formulating hypothesis followed by experimentation and subsequently leads to the collection of data and analysis. This research work therefore attempt to determine if the use of computer assisted instruction can help students to acquire the necessary process skills, enhance retention and performance in the learning of science concepts. The third model is a model of process skills by Wilson (1974) which try to illustrate the interrelationship between process and product.

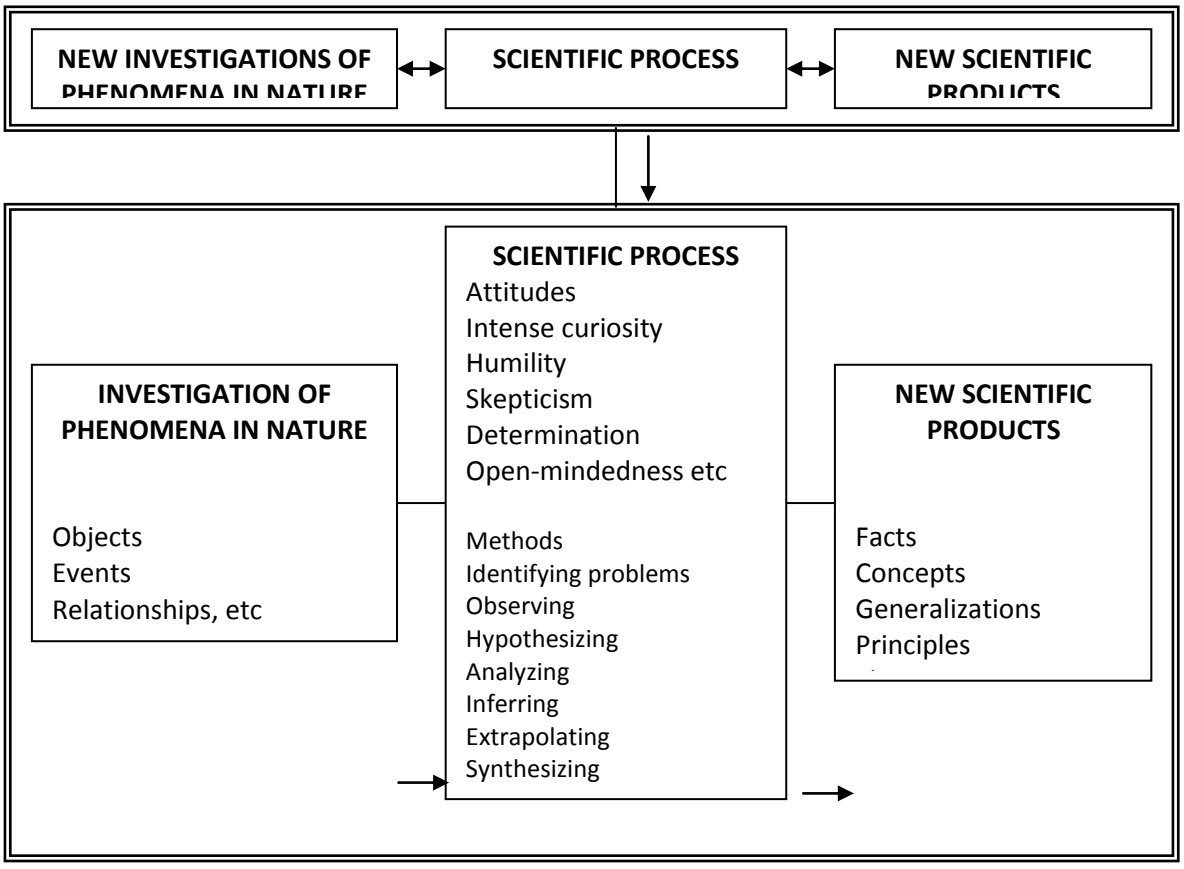


Fig. 2.3: Interrelationship between process and product
Source: Wilson (1974)

Another model of process skills is that of Wilson (1974) which attempts to describe the relationship between process and products. In essence it shows how natural phenomena can be investigated through the use of the various science process skills, and eventually leads to the acquisition of new scientific products, i. e. generate new facts and concepts, make generalization using their findings as well as establish principles, theories and laws. This research intends to determine if the use of CAI can enhance science learning, thereby generate new scientific products. The next model is a model of process skill by Wilson which illustrated the process model of scientific inquiry.

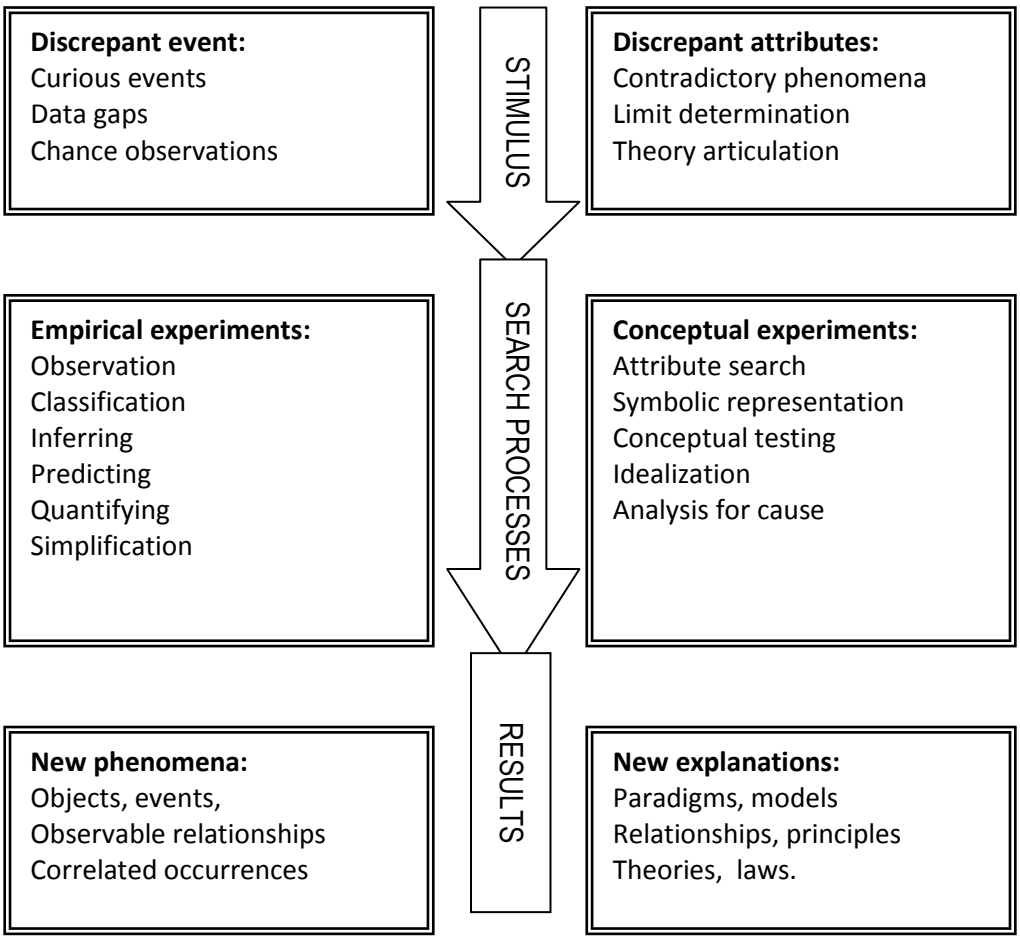


Fig. 2.4: **Process Model of Scientific Inquiry**
Source: Wilson (1974)

On the other hand Wilson's model (1974) provides two parallel sets of search processes, namely the empirical inquiry and conceptual inquiry. The search process in the empirical enquiry includes observation, classification, inferring, predicting, quantifying and simplification, where as the conceptual inquiry includes attribute search, symbolic representation, conceptual testing, idealization and analysis of cause and effect, all of which are embedded in the CAI package. Hence the research aims at discovering if the use of CAI can provide students with the ease to acquire the basic science process skills enhance retention of learnt concepts and improve performance.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) (1992) explained its own model of process skills as a means of developing concepts. Concept development is a set of activities that are carried out in order to achieve a certain goal. In a nut shell the UNESCO model of science process skills attempts to show how process skills can be used in learning new concepts through investigation. For the purpose of this research, the researcher adapted the UNESCO (1992) model of process skills, as a means of learning and understanding new concepts through a set of activities by the use of the CAI package. The choice of the model is because it will serve as an activity based method of instruction, since it will give the students the chance to carry out activities on their own, and can as well be giving an opportunity to repeat the various stages in order to enhance the acquisition of the basic science process skills, and enhance the retention of learned concepts Fig 2.5 UNESCO 1992 tried to illustrate how science process skill can be utilize during scientific investigation which will consequently lead to concept development and proper understanding of the concept.

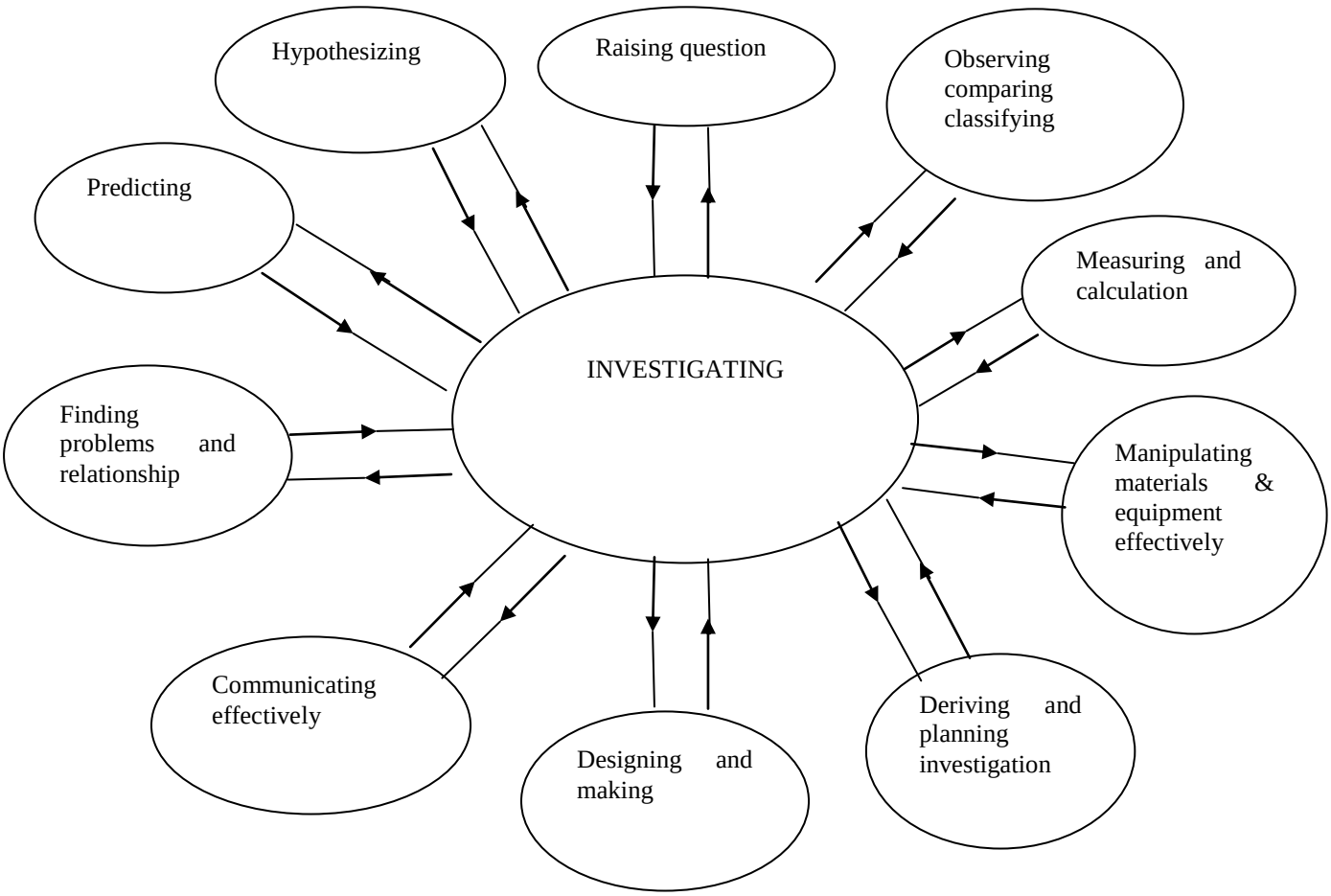


Fig 2.5: Process Skills as a Part of Scientific Investigation
Source: UNESCO (1992)

2.6 Retention of learned concepts in Science

Retention in learning literally denotes the ability to store or preserve facts and figures in memory. Retention is defined by Kundu and Tutoo (2002) as a preservative factor of the mind. The mind acquires the materials of knowledge through sensation and perception. These acquired materials in the mind need to be preserved in the form of images for knowledge to develop. The instructors' job is not finished until he/she have assisted the learners in retaining the information, and retrieving it when needed. For retention to be effective, learners must understand, interpret and apply the information. The learners understanding include their ability to assign the correct degree of importance to materials. Computer-Assisted Instruction can assist the learners to see relevance in the things that

they have learnt, and may help the learners to retain the new knowledge they have acquired.

Muhammad (2013) described retention as the ability to recall or recognize what has been learnt (experienced memory). Ausubel (1968) narrated that meaningful verbal learning and retention can be facilitated through the use of extrinsic organizing devices that can modify the learners' cognitive structure. He stressed that if existing cognitive structure is clear, stable, and suitably organized, it will facilitate learning and retention of new subject matter. However, if it is unstable, ambiguous, disorganized, or chaotically organized, it will inhibit learning and retention. According to Bichi (2002) retention is the ability to store and consequently remember things experienced or learned by an individual at a later time. Retention in learning according to Akaazua (2012) can also be seen as the ability of a working memory of an individual to retrieve stored information from the long term memory for processing.

Kundu and Tutoo (2002) defined retention as a preservative factor of the mind, as the mind acquires the materials of knowledge through sensation or perception. The acquired materials in the mind need to be preserved in the form of images or knowledge. Retention as the name implies can only be effective when the learner understand the concepts being taught because the level of understanding defends on the learner's ability to assign the correct degree of importance to the material. A comparative study on the effectiveness of guided discovery and concept mapping teaching strategies on student's retention ability by Novak, Gowin and Gerard, (2006) showed that there is a significant difference in favor of concept mapping strategy. Therefore, they reported that concept mapping strategy enable students to have better understanding of concepts being taught; as a result they tend to retain more.

It is very important for students to retain the knowledge and skills they have acquired in a learning situation otherwise the learned material will have no later significance. Several researchers like Ritter, Baxter, Kim, Srinivas, and Murhty (2010) argued that where ever learning is considered to be important, retention must be taken into consideration. Computer-Assisted Instruction (CAI) therefore can help students to understand and see relevance of the things they have learnt and can help them to retain the information. In another development an investigation on the effect of cooperative learning strategy on the retention level of students in cycle geometry showed that students who were taught using cooperative learning strategy retained the concept of cycle geometry more than the students who were taught through the use of conventional lecture method. It is therefore concluded that the conventional lecture method approach is effective in aiding retention. Maikano, (2010) sited that retention is significantly affected by students' level of understanding of the concepts being taught, the relevance of the learned material, the effectiveness of the teaching resources, and the level of involvement of the students. These factors are key elements in the Computer-Assisted Instruction (CAI) approach and can therefore help students to retain the concepts taught.

2.7 Gender issues in Basic Science and Technology

Gender refers to the state of masculinity or feminity in human beings. Some scholars refer to it as "Sex" which denotes the male or female. Others include hermaphrodite as gender. However, for the purpose of this research gender is only restricted to boys or girls. Sperlke (2005) made three claims about cognitive sex differences that account for differential representation of men and women in high level career like science and mathematics. In the first case, Sperlke (2005) suggested that males are more focused on objects from the beginning of a learning situation and therefore are predisposed to better learning. Secondly, he further proposed that males have profile of spatial and numerical

abilities producing greater aptitude for mathematics, sciences and technology. Finally, she opined that males have variable cognitive abilities that predominate in science, technology, and mathematics. He later found out that research on cognitive development in human infants, pre-school children, and students at all levels failed to support these claims. Instead she said it provides evidence that mathematics and scientific reasoning develop from a set of biologically based cognitive capacities that males and females share. These capabilities lead men and women to develop equal talent for science, technology, and mathematics. Ibrahim, (2012) reported that the tendency for girls to outperform boys in the classroom is due to differences on how girls and boys approach school work. They further narrated that girls are more likely to refrain from disruptive classroom behavior, and this predicted that girls will have greater efforts towards learning over time.

Haralambos and Holborn (2008) reported that in the U.K. girls and young women out perform their male counter parts at every level of educational system (from primary school to university). Sharpe (2004) discovered that from the 1990's girls priorities have changed from love, marriage, husband and so on to jobs and careers. He said that the change has helped to explain why educational attainment of girls is now greater than that of boys. Battista (2009) argued that sex difference in mathematics and sciences is due to the complex and poorly understood variables like previous performance, exposure to learning opportunities, socialization, sexual stereo typing, verbal and quantitative abilities. Huberty, (2009) explained that motivational and attitudinal considerations create greater anxiety among females than males, thereby making their retention ability better than their male counter parts and consequently performance better. Parents and teachers seem to under estimate girls' potentials in science, technology and mathematics; hence they are less likely to encourage girls who have talent in mathematics, sciences and

technology to develop those talents. Consequently the level of confidence in girls tends to drop and they lose interest in these areas. Sharpe (2004) deduced that societal status of women has been in existence for a long time, and the concern for low participation and performance of women in science, technology and mathematics has risen. However, the educational opportunities made available for girls have led to changing the roles of women in the society.

Nworgu, (2005) noted that significantly, both girls and boys are doing well in terms of performance in science and technology. Adole (2008) opined that the problem of gender imbalance in sciences and technology has reached a certain peak. He further warned that if this problem is left unchecked, a time will come when there will be no female science and technology teachers, no female engineer, and no female doctors and so on. In a study conducted by Ochur and Atager (2010) in Benue State of Nigeria, the findings revealed that the ratio of female to male student's performance in a science test is 1:5 in favour of male students. The difference in the performance was attributed to the result of gender unfairness factor, which diminishes the interest of female science students. Research findings showed that gender imbalance in science and technology education is not a recent trend because it has stretched back to pre- historic culture. They further revealed that the subjugation of a female lies in tradition, culture, and customs which are the cause of gender differences or imbalance. Raji, (2004) reported that other causes of gender imbalance in science education include early marriages among girls, lack of feminine role models and poor self concept. Offor (2007) narrated that it is important to note that research findings have made it clear that gender inequality has no basis as far as intellectual ability is concerned. Both males and females can be creative in their own way and have the tendency to score equally high grades if the interest is there.

2.8 Overview of Similar Studies

Advancements in information and communication technology have made considerable impact on educational practices. The use of computer- assisted instruction in the teaching and learning has become a new educational paradigm; hence, teachers are largely advice to adopt technology more, in order to enrich their instructional practices. A number of researches relevant to this study have been carried out and this section has given an overview of such studies.

Suwaid (2013) conducted a study on Technology-Assisted Learning (TAL) as a potential for the acquisition of basic science process skills and ICT skills by school children. Quasi experimental research design was used. The population of the study composed all primary schools in Kano metropolis. A sample of one hundred (100) primary school children randomly selected from different socio- economic backgrounds was used for the study. The instrument used for data collection was Basic Science Process Skills Test (BSPST). Data was analyzed using t-test. The findings of the study revealed that there was no significant difference between the performance of children exposed to TAL before school age and those that were not. Impliedly it proved that association with games (simple technology tools) has no effect on students' performance. It is therefore recommended that children should not be exposed to the use of simple games before primary school. The present study is similar to the reviewed study as both studies were involved in the use of CAI to enhance science process skills acquisition. However, the studies dissimilar as the reviewed study was conducted among primary school student while the present study was conducted among Junior Secondary Schools students.

Thomas and Stocton (2010) investigated the impact of Computer-Assisted Instruction on retention and performance in Ecology concept among high grade students in Island (UK). Quasi experimental control group design was used for the study. The population of the

study was composed of 148 students, out of which 50 students were used as sample for the study. The instrument used was Ecology Performance Test (EPT). t-test statistic was used to analyzed the data. The result of the finding indicated that retention ability was higher among female students. They recommended that the used of CAI should be encouraged in teaching ecology concept among female students high grade. The reviewed study is similar to the present study by using CAI however it showed disagreement with present study as it proved to be gender biased.

Sulaiman (2010) Effect of inquiry teaching method in Academic Performance, Retention and Attitude towards Chemistry among Diploma II students of Kano state Polytechnic. Quasi experimental research design was used for the study. A population size of the study composed 1058 with a sample of 135 students was used for the study. The instrument used for data collection was Chemistry Performance Test (CPT). Data collected were analyzed using t-test. The findings of the study showed that there was significance difference in the academic performance of students taught chemistry concepts using inquiry teaching method compared with their counterparts exposed to lecture method. There was significant difference in the retention ability of learned concepts using inquiry teaching method compared to their counterparts exposed to lecture method. He recommended that since inquiry teaching method has been found to enhance academic performance and retention it should be used in teaching of some chemistry concepts. The reviewed study is similar to the present study as it tested retention ability and performance and they differ in the use of the teaching methods.

Bork (2013) conducted a study on Computer-Assisted Instruction in Tartu, Estonia (UK) to test the effect of computer usage on skills and performance among second year students of Physic in Valley College. In conducting this study a quasi-experimental design was used. The population of the study is composed of 23 schools. The sample of

the study was 300 students. Two groups were used for the purpose of the study (an experimental and a control group). The students in the experimental group were exposed to an extensive treatment using a Personalized System of Instruction (PSI) using computers. The second group was exposed to treatment using text books. The course was self-phased; so students were given the choice of using their own pacing strategy. The instrument used for the study was Physic Performance Test (PPT). The course was designed as a mastery based course. The course was organized into smaller modules and each module is centered on carefully chosen set of objectives.

At the end of each module, the students were given a test. The result obtained was analyzed using t-test. The findings of the study showed that the students that used PSI as teaching aid had significantly acquired the science process kills better, due to the interaction they had with the computers. Therefore they were significantly faster and better in their task accomplishment. It is therefore recommended that CAI should be use in science Teaching as it enhances skills acquisition and performance. This study is similar to the present study in the following ways: students were allowed to use the computers on their own the treatment was designed and based on a Personalized System of Instruction (PSI), which is similar to the Computer Soft Ware Package (PCSWP) that is used for this study. The courses are both designed in such a way that at the end of each module or segment, the students would be given some form of assessment. However the only difference in the two studies is that in the present study the students in the control group did not use text book, instead they were treated using lecture method only, where the students played a passive role. Also this study was self phased while in the present study the students were given time to achieve the stated objectives. Finally, the present study was conducted in Basic Science classrooms as opposed to the former that was conducted in physics classrooms.

Hui, (2007) conducted a research study on Computer-Assisted Instruction (CAI). A longitudinal field study of knowledge category learning effectiveness and satisfaction in language learning at a major University in Hong Kong. The research design used for the study was quasi-experimental. The population of the study comprised 800 Language Students in Hong Kong University. The sample used for the study was 104. The instrument used for the study was Language Performance Test (LPT). Data obtained was analyzed using ANOVA. The finding of the study revealed that the use of CAI has helped the students to recall the concepts being learned and improved performance. The research proved that computer-assisted instruction supports vocabulary learning better than the lecture method. However it is comparatively less effective in developing listening and comprehensive skills. It is therefore recommended that the use of CAI should be emphasized in the teaching of languages. This study is similar to the present study as it aimed in testing the effect of CAI. However, it is dissimilar the sense that the reviewed study tested the effect of CAI in language teaching whereas the present study was involved in testing the effect of CAI in the teaching of Basic Science

Christian (2007) investigated on the effect of the use of interactive multimedia board on student's perception among secondary school biology students in Caucasia Sophomores in U.S.A. in this study quasi experimental design was used. The population for the study consisted of 1200 First year Biology Students in a high school. The instrument used for the study was a Semi Structured Interview (SSI).Sample of 100 students was drawn from a population. Analysis of the result obtained was done using t-test. The result proved that students found the use of interactive multimedia board more interesting and it has helped the students to perceive better. It is therefore recommended that interactive multimedia board should be used in teaching some biology concepts as it helped to improve retention and performance. This study is similar to the reviewed study because they were both

involved in the use of technology tools. However, they are dissimilar as the reviewed study used interactive multimedia board not computer.

Geddes and Goraset (2010) who investigated the effect of Technology-Assisted Instruction on Gender and Retention ability among Senior Secondary School Biology Students in Uganda. Quasi-experimental research design was adopted for the study. The population consisted of 400 students with broad line intellectual ability (IQ) between (70 and 85). The sample of study was 30 students, 17 female and 13 male. The instrument used for the study was Basic Achievement Skill Inventory (BASI). Pearson Correlation and Multiple Independent t-test were used to analyze the impact of IQ. The finding revealed that Technology-Assisted Instruction enhanced Retention and is Gender friendly. It therefore recommended that TAI should be used as a tool to teach sciences as its effect has revealed enhance retention and is gender friendly. The study is similar to the present as it involved the use of TAI in the teaching of science concepts. However, there is a difference between the two studies as the reviewed study was conducted among Senior Secondary Biology Students while the current study was done among Basic Science Students.

Neuman, Neuman and Hood, (2011), also examined whether the use of a computer has an effect on students' participation during lesson in elementary schools in the sub-urban area in the United States of America. Research design used for the study was quasi-experimental. The population of the study comprised 21 elementary schools in the sub-urban area USA. Sample of 80 students was drawn from four schools in the population. The instrument used for the study was Students' Perception Inventory (SPI). The result obtained was analyzed using t-test in order to determine the effectiveness of the intervention. The finding of the study revealed that the use of the computers in the classroom had encouraged students' participation during learning, which is an indication

of Science Process Skills acquisition. It is recommended that science should be taught using modern teaching strategies like CAI. It is similar to the present study as the use of CAI was involved for the study. However, there is difference between the two studies as the reviewed study used perception inventory while the current study used BSPT for the data collection.

Nwafor, (2014) investigated on the relative effects of Synchronized Multimedia (SM) on the academic performance and motivation of senior secondary school biology students in Port Harcourt, Nigeria. Quasi experimental design was used for the study. The population of the study consisted of 1254 students. The sample used for the study was 130 students who were grouped into experimental and control groups. Two instruments were used for the study. The Synchronized Multimedia Performance Test (SMPT) and Synchronized Multimedia Questionnaire (SMQ). Pearson Product-Moment Correlation Coefficient (PPMCC) was used to analyze data. The finding of the study revealed that students taught biology using synchronized multimedia performed significantly better and were more motivated than those taught using lecture method. It is recommended that the use SM should be encourage as it motivates students. The study is similar to the current study as the use of technology tools is involved. However, the reviewed study was done among senior secondary school biology students. While this study was done among Basic Science Students.

Putman (2010) conducted a similar research in Northern Ohio, U.S.A. The study investigated the effect of teaching English Language, Arts, and Mathematics using Power Point Presentation (PPP). Quasi-experimental research design was used. The population of the study was 645 from 10 schools. A sample of 80 students was used. The instrument used for the study was English Language Performance Test (ELPT), t-test statistical tool was used to analyzed data. The finding of the study revealed that the performance of

students who were taught using Power Point Presentation was not significant. It is recommended that teachers should use power point presentation as a means of enhancing teaching. The study is similar to the present study as it involved the use of technology tools. However, it is different in the sense that the reviewed study was conducted in English Language, Arts, and Mathematics while the current study was conducted only in Basic Science.

Svetsky, Moravick, Ruskova, Balog, Sakal and Tanuska (2011) presented an article that described a five-year period of Computer-Enhanced Learning (CEL) implementation at the faculty of Material Science and Technology, in Trnava (Western Slovakia). The research design used for the study was quasi experimental. The population for the study consisted of four institute with more than 600 under graduate students and teachers of technical subjects. The sample for the study was 120 of which 100 were students while the remaining 20 were teachers. Instrument used for data collection was Science and Technology Questionnaire (STQ). From the finding of the study it was observed that the implementation of CEL brought about improvement and benefited over 600 students from several institutions as it enabled them to get access to the data base applications needed for the program. It is recommended that the use of Computer-Enhance Learning (CEL) should be encouraged to teach science and technology. In this study it was the teachers that made use of the computer to the to implement the teaching process, as opposed to the present study that allowed the students to manipulate the computers themselves in order to acquire skills or improve the already acquired skills. Another difference is that the subjects of this study are adults, where as in the current study the subjects under study are all teenagers.

In another related study, Muddassir (2011) investigated on the importance of Information Communication Technology (ICT) in empowering teachers and learners thereby

enhancing students' performance in Kano State Nigeria. A survey type of research design was adopted. The population of the study consisted NCE 3 students of various Colleges of Educations in Kano State. A sample of 382 subjects (181 males and 201 females) was used for the study. Data was collected by using Information Communication Technology Questionnaire (ICTQ). Data obtained was analyzed using percentage, mean, and Chi-square statistics. The findings revealed that majority of the subjects have positive attitude towards the use of CAI. However, there was no significant difference established between the attitude and competence of male and female subjects. The only problem is that the student-teachers lacked the necessary competence in the full integration of CAI into the curriculum. It is recommended that the use of ICT should be emphasized among science teachers and students. This study is similar to the present study as share same variables and dissimilar as the present study was carried out among Basic Science Students while the reviewed one was conducted among tertiary institutions of learning.

Belal (2011) conducted a research on students' perceptions on computer-assisted learning at the Ashton Business School, Aston University, Birmingham. A survey research design was used for the study. The population of the study consisted of 5 departments. A sample of 50 students was used. The instrument used was Students Perception Questionnaire (SPQ). Data obtained was analyzed using t-test. The finding suggested that the students were in favour of using the computer assisted instruction in a supportive role only. The interviewees rejected the idea of replacing human tutors with machine tutors and they believed that most of their learning occurs in tutorials. It is recommended that the use of CAL should be used in business schools. This study is similar to the present study, as they aimed at testing the effect of CAI. However, there was a difference in the research design adopted.

Nduke (2011) attempted to find out the effectiveness of the use of computer assisted instruction and lecture method on student's academic performance among science education students in Federal College of Education Zaria, Kaduna State, Nigeria. Quasi experimental research design was used. The population of the study composed of NCE II Computer Science Education Students. One hundred students (100) were selected out of five hundred and fifty (550). The sample was divided into two groups. The instrument used for data collection was Computer Usage Achievement Test (CUAT). Mean and standard deviation were used to test the significance difference at 0.05 alpha levels. Based on the result obtained from the analysis of the data, it was found that students taught with the use of computer retained the concepts being taught and hence performed better than those that were taught using lecture method. It is therefore recommended that the use of CAI should be encouraged by both Federal and State Ministries of Education. The study reviewed was similar to the present study as they used CAI and the same research design. They are dissimilar as the present study used Basic Science Students while the reviewed study was conducted among N. C. E. students.

Abu (2008) conducted a study to investigate the effectiveness of computer- based science simulations and lecture methods on students' performance in biology among senior secondary school students. Quasi experimental research design was used. The population of study composed of all the senior secondary schools in Zaria education zone, Kaduna State, Nigeria. A sample 60 students were randomly selected. The instrument used for the collection of data was Science Achievement Test (SAT). The test items were found to have a reliability index of 0.83, using the test re-tests approaches. Data was analyzed using t-test statistical tool. The finding of the study revealed that students taught with computer-based science simulations instruction performed better in science, than those taught using the lecture method. It is therefore recommended that science teachers should

adopt the use of CAI in science classes. Both study tested the effectiveness of CAI and the same research design. However, they are dissimilar in the sense that the present study emphasized the use of CAI in the acquisition of Science Process Skills.

In another study Chukwuka, (2009) conducted a study on students' perception on computer simulation usage to teach concepts of evolution in biology among NCE students of Federal College of Education Ibadan , Oyo State, Nigeria. The study adopted quasi experimental design. The population of the study was 1850 students from the department of biological sciences. A sample of 500 students was randomly selected. Instrument used for the study was Students Perception Computer Simulation in Biology Questionnaire (SPCSBQ). Percentage score was used to answer the research questions, and the hypotheses were tested using ANOVA statistics at 0.05 level of significance Results of the findings revealed that NCE students have positive perception of computer simulation usage in biology. It recommended that teachers should adopt the use of computers on simulation to teach science concepts. The study is similar to the present study as it involves the use of computers in teaching science concept. However, it is dissimilar in the sense that the reviewed study was conducted among NCE Students as opposed to the present study that was conducted among Basic Science Students in Junior Secondary Schools. In addition the reviewed study CAI was used to teach evolution concept while the present study used CAI to teach pollution concept.

Similarly Mouneme (2012) investigated the impact of enriched lecture method with interactive multimedia board on academic achievement and interest of biology students in Rijau education zone, Niger State, Nigeria. The study was based on pre-test/post –test experimental and control group design. Fifteen (15) schools were used as population for the study. The sample of the study was made up of eighty (80) students, where fifty (50) students participated in the control group while thirty students (30) participated in the

experimental group. The project was designed in order to find out whether the integration of computer based/ multimedia enriched lecture approach in the Rijau educational zone classrooms of Niger State would improve the students learning outcome and ginger students interest. The research was guided by two research questions and two hypotheses. The learning outcome was compared in terms of students' academic achievement and motivation through the result obtained from the students' computer based/multimedia enriched-lecture approach interest questionnaire (CB/MMELAIQ) and Evolution Achievement Test (EAT). The data was analyzed using t-test. The finding of the result showed increased interest and improved academic achievement by the experimental group. It was recommended that the use of CAI should be encourage as it can boost students' interest thereby enhances academic achievement.

2.9 Implications of Literature Reviewed on the Present Study

From the various studies that were reviewed both in sciences and other general subjects, most of the studies on Computer-Assisted Instruction are relatively new and most of them were conducted outside Nigeria. Few of the studies that were done in Nigeria, mostly involved tertiary institutions and senior secondary schools. More over in the literature that was so far reviewed none of the researchers attempted to find out if the use of CAI would have any effect on the Acquisition of Science Process Skills, and none of the literature so far reviewed, investigated the effect of Computer -Assisted Instruction among Basic Science students. In this regard this research study intends to find out the Effects of Computer-Assisted Instruction (CAI) on the Acquisition of Science Process Skills, Retention and Performance among Basic Science Students in Kano, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study was conducted to find out the Effect of Computer-Assisted Instruction (CAI) on Acquisition of Science Process Skills, Retention and Performance among Basic Science Students in Kano, Nigeria. This chapter is discussed under the following sub headings:

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Technique

3.5 Instrumentation

3.5.1 Basic Science Performance Test (BSPT)

3.5.2 Process Skills Acquisition Test (PSAT)

3.5.3 Validation of Instruments

3.6 Pilot Study

3.6.1 Reliability Coefficient of Instruments

3.6.2 Test Items Analysis

3.7 Administration of Treatment

3.8 Data Collection Procedure

3.9 Data Analysis Procedure

3.9.1 Research Question Analysis

3.9.2 Analysis for Null Hypotheses

3.2 Research Design

The research design adopted for this study is a quasi-experimental control group design employing pretest, posttest and post-posttest as recommended by (Kerlinger, 1973). A

pre-test was administered to both the experimental and control groups using same test instrument before treatment; so as to determine the entry level. The treatment was done by teaching pollution concepts to the experimental groups, using Computer - Assisted Instruction (CAI). The teaching was done by exposing the students in the experimental group to work on a Personalized Computer Soft Ware Package (PCSWP). The control group was taught the same concepts using lecture method. A post-test was administered after six weeks of the treatment using the same test instrument so as to determine the effectiveness of the treatment. After two weeks a post-posttest was administered to test the retention level of the two groups as recommended by (Tuckman 1975).

The research design is illustrated graphically as follows:

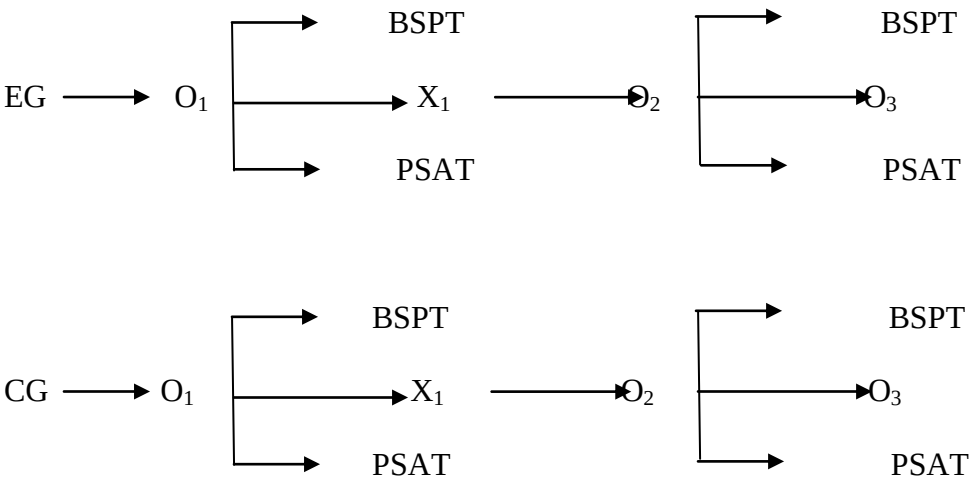


Fig. 3.1: Research Design Illustrations

Where:-

EG	=	Experimental Group
CG	=	Control Group
O_1	=	Pre- Test
O_2	=	Post Test
O_3	=	Post- Posttest
BSPT	=	Basic Science Performance Test
PSAT	=	Process Skills Acquisition Test
X_1	=	CAI
X_1	=	Lecture

The research design was designed by the researcher based on the following advantages as outlined by Gay, Mills, and Airasian, (2009).

1. The pretest result was used to determine if the two groups are homogenous in ability before the commencement of the treatment.
2. The result obtained from the posttest was used to analyze the effectiveness of the treatment when compared with the control group
3. The result obtained from post posttest was used to determine the level of retention of the context learnt.
4. The design has the advantage of providing information about the effect of the treatment both immediately and at a later date. That means it can be used to measure the retention level among the students.
5. It can also give an indication of the concept attainment ability gained by students after the treatment.

3.3 Population of the Study

Kano Metropolis is made up of eight Local Government Areas for the purpose of data collection only one local government (Municipal Local Government) was used for the study. There are forty-one (41) Junior Secondary Schools in Municipal Local Government of Kano State. Out of the forty one schools, twenty two are males, with a population of four thousand eight hundred and seventy (4, 870). The remaining nineteen schools are females with a population of three thousand two hundred and sixty one (3,261). There are no co-educational schools among the Government Junior Secondary Schools in the population. The total enrolment of the JSS II students in Municipal Local Government is Eight thousand, one hundred and thirty-one (8,131). The ages of the students ranges from twelve to fourteen years of age. All the students in the Junior Secondary Schools offer Basic Science, as it is one of the core subjects. Table 3.1is a summary of the population for the Study.

Table 3.1: Population of the Study

S/N	Name of School	No. of Males	No. of Females
1	GJIS A. Sadiq	180	
2	GJSS Ado Yola	79	
3	GJSS Dan Agundi	164	
4	GJSS Jakara	120	
5	GJSS Jarkasa	80	
6	GJSS Kabiru Kiru	120	
7	GJSS K/Wambai	65	
8	GJSS Kurmawa	130	
9	GJSS Kwalli	189	
10	GJSS Mayanka	63	
11	GJSS Salanta	125	
12	GJSS Shahuci	288	
13	GJSS Tukuntawa	288	
14	GJSS Yanbita	178	
15	GSS Ado Gwaram	320	
16	GSS Kofar Nasarawa	198	
17	GSS Sabuwar Kofa	519	
18	GSS Sharada	627	
19	HIS Shahuci	191	
20	Maigari Sheshe	98	
21	Rumfa Coll. Kano	384	
22	S. A. S. Kano	464	
23	Hafsat Delu		100
24	GGSS M. Aloma		340
25	GGSS Shekara		280
26	Umma Zaria Koki		121
27	City Women Center		187
28	GGASS Koki		150
29	GGASS Zoo Road		104
30	GGJAS Hasiya Bayero		275
31	GGJISS Maryam Shekarau		180
32	GGJSS Gidan Makama		120
33	GGJSS Kurna D/Z		97
34	GGJSS Rimi City		111
35	GGJSS Yakasai D/Z		113
36	GGJSS Yakasai S/Unguwa		100
37	GGSS Festival		150
38	GGSS Gandun Albasa		310
39	GGSS Kofar Kudu		120
40	GGSS Sharada		240
41	GGSS Yakasai		163
	TOTAL	**4,870**	**3,261**

Source: Kano State Secondary School Management Board (KSSSMB) (2014)

3.4 Sample and Sampling Procedure

The sample for this study is made up of four schools. Simple random technique was used to select the sample from the population. The selection was done by selecting ten schools by tossing from the population and was subjected to a pretest. The scores obtained from

the test were subjected to ANOVA and later used scheffe's test to select four schools. The selected schools were found to be equivalent in terms of their performance. Out of the four schools, two were male and the other two were female schools. An intact class of JSS II was picked from each schools using simple random sampling of balloting. The selected schools were tagged Experimental and Control groups respectively. Table 3.2 shows the Sample for the Study.

Table 3.2: Sampled Schools for the Study

S/N	Name of School	Gender	No Sampled
1.	Experimental 1	Male	50
2.	Control 1	Male	50
3.	Control 2	Female	50
4.	Experimental 2	Female	50
Total			200

The sample size that was used for the study is considered to be adequate. According to Gay, Mills and Airasian (2009) a sample of thirty students is satisfactory for an experimental study.

Selection of topic for the study

The choice of pollution concept is motivated by so many reasons of which include:

1. Living things are dependent on their environment for survival hence the need for awareness on the dangers that are inherent to the environment
2. Technological advancement has given man the ability to exert great influence over the environment and for this reason it is necessary to have an understanding of the factors that causes pollution and the control measure in order to alleviate the problems associate with it
3. Clear knowledge of the control measures will help farmer to grow their crops as well as to rear their livestock under suitable environmental condition, moreover
4. Knowledge of the hazardous effects of water pollution is very important as it will help to protect the lives of aquatic inhabitant

3.5 Instrumentation

Two instruments were used for data collection. These instruments are:

1. Basic Science Performance Test (BSPT) and
2. Process Skills Acquisition Test (PSAT).

3.5.1 Basic Science Performance Test (BSPT)

Basic Science Performance Test (BSPT) is a performance test adapted from the Junior Secondary School Certificate Examinations for Kano State (JSCE, 2009-2014). The Basic Science Performance Test (BSPT) instrument contains forty (40) structured multiple choice items with one correct answer and three distracters for each set. The test items covered all the concepts taught under pollution. The items for the BPST were designed according to Bloom's Taxonomy as shown in table 3.3. The BSPT was administered on both the experimental and the control groups. It was used as pretest, post test and post-posttest. The purpose of this instrument was to assess the level of students' retention ability and performance before and after treatment. The outcome of this administration was used to determine the effect of the use of Computer-Assisted-Instruction (CAI) on retention and performance among basic science students in Kano Metropolis.

Table 3.3: Table of Specification for BSPT of Blooms' Taxonomy

Content	Weight	Kn	Co	Ap	An	Sy	Ev	Total
Definition and types of pollution	10	5	1	1	0	0	0	7
Air pollution, cause, effects, & control measures	30	5	4	0	1	1	1	12
Water pollution, causes, effects,& control measures	30	6	1	0	2	0	0	9
Land pollution, causes, effects and control measures	30	6	0	2	4	0	0	12
Total	100	22	6	3	7	1	1	40

Source: adapted from Obeka (2010)

Key: where

Kn = Knowledge

Co = Comprehension

Ap = Application

An = Analysis

Sy = Synthesis

Ev = Evaluation

3.5.2 Process Skills Acquisition Test (PSAT)

The Process Skills Acquisition Test items (PSAT) was adapted from Usman (2014) to test the level of science process skills acquired based on the various pollution concepts taught. The PSAT composed of four experiments that were conducted by the students, with the assistance of the researcher. There are 5 questions under each experiment, given a total of 20 questions to be answered. The answers were provided by the students and had enabled the researcher to test the level of acquisition of the Basic Science Process Skills, (Observation, Measurement, Classification, Inferring, Prediction and Communication).

3.5.3 Validation of Instruments

The BSPT was validated by experts in the Science Education and English Departments of Ahmadu Bello University, Zaria, with a minimum qualification of Ph.D. The essence of the validation was to check the face and content validity of the instrument. Process Skills Acquisition Test (PSAT) was equally validated team of expert. Constructive criticisms were made to ascertain the validity of the instrument.

3.6 Pilot Study

The Pilot study for this work was carried out on JSS II students of G.G.S.S. Shekara in Kano Municipal Local Government. This school is part of the population but not part of the selected samples for the study. The aim of the pilot study was to determine the characteristics of the test items, which includes their facility and discrimination indices

and reliability coefficient. The pilot study was conducted away from the study area in order to avoid interaction with the main subjects of the study.

G.G.S.S. Shekara has a population of two hundred and eighty (280) JSS II students, out of which only fifty (50) students were selected to participate in the study. The fifty students were divided into five (5) groups, so as to ensure that the computers were adequate for the study. Before the commencement of the study, the researcher made a brief explanation to the research assistants how to conduct the research. The researcher then made a Power Point Presentation for the students so as to give them an idea of how to handle the computers in order to get the information needed. The students were allowed and guided to learn pollution concepts using a Personalized Computer Software Package. The teaching was conducted for a period of three weeks before the administration of the instruments. A period of two weeks was allowed to elapse between the first test and the second test. The result of the pilot study was used to assess the reliability coefficient of the test items. (Appendix 10)

The essence of the pilot study was to:

1. Determine the reliability of the instruments before administration.
2. Asses the feasibility of the study before administration
3. Identify and try to minimize the expected problems that the students will likely encounter.
4. Asses the clarity of the two instruments (BSPT) and (PSAT).
5. Determine the number of weeks that will be adequate for the study.
6. Determine the difficulty and discrimination level of the test items.

3.6.1 Reliability of the Instrument

The two instruments Basic Science Performance Test (BSPT) and the Process Skills Acquisition Test (PSAT) were administered to 50 students of Government Girls

Secondary School Shekara. For the test re-test of these instruments only two weeks was allowed to elapse between the first test and the second test, in order to minimize the intervention of external factors in the final reliability coefficient that would be obtained. However one of the subjects in the Basic Science Performance Test (BSPT) was unavoidably absent in the second test and was omitted in the computation of the reliability index.

The result obtained from the pilot study was subjected to alpha procedure with the SPSS package, and the result indicated an alpha coefficient of 0.84 with internal consistency coefficient of 0.84 for the Basic Science Performance (BSPT) while for the Process Skills Acquisition Test (PSAT) reliability index was 0.76 and its internal consistency coefficient was 0.76 respectively.

The SPSS output for the two tests are attached in the appendices respectively. The reliability coefficients obtained (0.84 for BSPT and 0.76 for PSAT) are in line with Natasha (2014) who advanced that a reliability coefficient between 0.5 and 1 is expected to be obtained for an instrument, which implies that the instrument is reliable and internally consistent for a study. To filter out any form of intervention by external factors in the tests, the intra-class correlations which is usually unaffected by any shift in mean on re-test, was used for elimination of such bias and they gave the same coefficients. These are clearly indicated that the instruments are reliable and internally consistent for the study.

3.6.2 Items Analysis of BSPT and PSAT

a. Item Difficulty Index

Item analysis was carried out from the pilot testing score to determine the item difficulty and discrimination indices. Sambo (2008) has defined item difficulty as a measure of the

percentage of the people or candidates who got the item right over the total number of candidates that attempted the item. It is determined by using the formula below:

FI $= \frac{R}{T} X\ 100$

Where: R, is the number of candidates who got the item right

T, is the total number of candidates

Sambo (2008) further recommended that items with difficulty index between 40% to 60% be accepted. For the present study, items with difficulty index of 40% to 60% are retained. Item below 40% are considered be too easy, and 60% being too difficult Appendix 7 and 8 respectively.

b. Item Discrimination Index

The discrimination index of the test is the ability of the test item to separate between high and low-ranking students in the entire test. This was calculated using the formula given by (Furst in Olorukooba, 2001)

$$DI = \frac{RU - RI}{N}$$

Where: D I = discrimination index of test item

RU = number of candidates that got the item correct in the upper 27% of the group.

RI = number of candidates that got the item correct in the lower 27% of the group

N = number of candidates in the 27%upper or lower part of the group

Sambo (2008) has posited that items of discrimination index of 0.40 and above are very good for the study, 0.30 – 0.39 are reasonably good, 0.20 – 0.29 are marginal items that need improvement, while items with discrimination index of 0.19 and below are poor items to be discarded. Thus in this study, items ranging between 0.40 – 0.60 were accepted for final selecting of BSPT and PSAT instruments. (Appendix 4 & 5).

3.7 Administration of Treatment

Experimental group: The treatment for the experimental group was coordinated and supervised by the researcher and assistants. The researcher gave an explanation to the research assistants on how to guide the experimental group to take their lesson using Computer-Assisted-Instruction.

- The software was installed into the student's computers before the commencement of the instruction.
- The teacher gave a general preview of the pollution concepts using Power Point Presentation.
- The students were guided by the researcher and the research assistants on how to take their lessons using a Personalized Computer Software Package (PCSP) on a weekly base.
- At the end of each lesson the students were guided on how to take a home work from their computers.
- The same procedure was followed for each week's instruction, until all the concepts were exhausted.

Control Group: The control group was taught pollution concepts by the researcher, using lecture method. The lesson took place in the classroom, and lasted for 40 minutes each. At the end of each lesson students were given a take home assignment. The treatment lasted for six weeks, after which both groups were tested using the instruments. (Appendix 5)

3.8 Procedure for Data Collection

Basic Science Performance Test (BSPT) and Process Skills Acquisition Test (PSAT) appendix 1 and 3 respectively were administered at the beginning of the exercise as pretest to determine the entry level of the students. Lesson was carried out in accordance

with the lesson plan for both experimental and control groups as indicated in appendix 5 and 6 respectively. The BSPT and PSAT were used to collect data after the administration of treatment as posttest. After a period of two weeks, post-posttest was administered. The scores of the experimental and control groups were recorded separately and subjected to data analysis.

3.9 Procedure for Data Analysis

The research questions were answered using descriptive statistic of mean and standard deviation. Inferential statistical of t-test was used to test the research hypotheses. Data generated were analyzed at $p \leq 0.05$ level of significance. The following are the

Research Questions:

1. What is the difference in the level of Performance between Students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method?
2. What is the difference between the Science Process Skills Acquired in Students that were taught using Computer-Assisted Instruction (CAI) and those taught using Lecture Method?
3. What is the difference in the Retention ability between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method?
4. What is the difference in the level of Performance between Male and Female students taught Basic Science concept using Computer Assisted Instruction?
5. What is the difference in the level of Science Process Skills acquired between Male and Female students taught Basic Science concept using Computer Assisted Instruction?

6. What is the difference in the level of Retention between Male and Female students taught Basic Science concept using Computer Assisted Instruction?

Null Hypotheses Testing

The following Null hypotheses are set to be tested at $P \leq 0.05$ level of significance

$H0_1$: There is no significant difference in the level of performance between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method

This hypothesis was analyzed using t-test

$H0_2$. There is no significant difference in the acquisition of Science Process Skills of students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method.

This hypothesis was analyzed using t-test

$H0_3$: There is no significant difference in the level of Retention between students taught Basic Science using Computer-Assisted Instruction and those taught using Lecture Method.

This hypothesis was analyzed using t-test.

$H0_4$: There is no significant difference in the level of Performance between male and female students taught Basic Science concept using Computer Assisted Instruction.

This hypothesis was analyzed using t-test.

$H0_5$: There is no significant difference in the level of Science Process Skills acquired between male and female students taught Basic Science using Computer Assisted Instruction.

This hypothesis was analyzed using t-test.

$H0_6$: There is no significant difference in the level of retention between male and female students taught Basic Science using Computer Assisted Instruction.

This hypothesis was analyzed using t-test.

CHAPTER FOUR

DATA ANALYSIS: DISCUSSION AND PRESENTATION OF RESULTS

4.1 Introduction

The main objective of the study was to find the Effect of Computer-Assisted Instructions on Acquisition of Science Process Skill, Retention and Performance among Basic Science Students in Kano Nigeria. To achieve this six research questions were, asked and answered, and six null hypotheses were also tested at p = 0.05 level of significant.

4.2 Answering Research Questions

Research Question One: What is the difference in the level of Performance between Students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method?

To answer this research question descriptive statistics of mean and standard deviation was used. The summary of the finding is seen in Table 4.01.

Table 4.01: Mean Score of Performance for Experimental and Control Groups

Group	N	Mean pretest	Mean posttest	SD	MD
Experimental	100	12.19	27.75	3.63	8.69
Control	100	11.86	19.06	2.35	

Table 4.01 revealed that there was a difference in the performance between students taught Basic Science concept using Computer-Assisted Instructions and those taught using lecture method. The pretest mean scores of experimental and control groups are 12.19 and 11.86 respectively. The posttest mean scores of performance between the Experimental and Control groups are 27.75 and 19.06 respectively with mean difference of 8.69 in favor of the experimental group.

Research Question Two: What is the difference between the Science Process Skills Acquired in Students that were taught using Computer-Assisted Instruction (CAI) and those taught using lecture method?

To answer this research question descriptive statistics of mean and standard deviation was used. The summary of the finding is seen in Table 4.02.

Table 4.02: Mean Score of Science Process Skill Acquisition between Experimental and Control Groups

Group	N	Mean pretest	Mean posttest	SD	MD
Experimental	100	6.33	9.69	4.85	
					2.48
Control	100	6.01	7.27	2.64	

Table 4.02 revealed that there was a difference in the acquisition of Science Process Skills between students taught Basic Science concept using Computer-Assisted Instructions and those taught using lecture method. The pretest mean scores of Experimental and Control groups were 6.33 and 6.01 respectively. The posttest mean scores of Experimental and Control groups were 9.69 and 7.27 respectively with mean difference of 2.48 in favor of the experimental group. This showed that the mean scores of Science Process Skill Acquisition of the Experimental group were significantly higher than that of the Control group.

Research Question Three: What is the mean difference in the level of Retention ability of students taught Basic Science using Computer Assisted Instruction and those taught using Lecture Method?

To answer this research question descriptive statistics of mean and standard deviation was used.

The scores of the post posttest for both experimental and control group were used to analyze the level of retention ability between students taught basic science concept using Computer-Assisted Instruction. The summary of the finding is seen in Table 4.03

Table 4.03: Mean Score for Level of Retention between Experimental and Control Groups

Groups	N	Mean	Std. Dev	MD
Experimental	100	29.49	5.265	
				16.77
Control	100	12.72	3.452	

Table 4.03 showed that there was a difference between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method. The computed mean scores of Retention are 29.49 and 12.72 implying a mean difference of 16.77 in favour of the Experimental group.

Research Question Four: What is the mean difference in the academic Performance of Male and Female students taught Basic Science using Computer-Assisted Instructions

To answer this research question descriptive statistics of mean and standard deviation was used. The posttest scores of the experimental group was used to analyze the level of performance between male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.04

Table 4.04: Mean Performance Score for Male and Female Students in Experimental Group

Group	N	Mean	SD	MD
Male	50	27.81	6.81	
				0.12
Female	50	27.69	6.66	

Table 4.04 showed that there was a difference in the level of Performance between Male and Female Students taught Basic Science concept using Computer-Assisted Instructions. Descriptive statistics revealed that the male and female performance scores were 27.81 and 27.69 respectively with mean difference of 0.12. This showed that the Computer-Assisted Instruction provided the same positive effect for both male and female students.

Research Question Five: What is the mean difference in the level of process Skills acquired between Male and Female students taught Basic Science concept using Computer-Assisted Instruction?

To answer this research question descriptive statistics of mean and standard deviation was used. The posttest scores of the experimental group was used to analyze the level of Science Process Skills Acquired between male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.05

Table 4.05: Mean Score for Science Process Skills between Male and Female Students in Experimental Group

Group	N	Mean	SD	MD
Male	50	10.08	8.41	
				0.39
Female	50	9.69	7.27	

Table 4.05 showed a difference in the level of Science Process Skills acquired between Male and Female students taught Basic Science concept using Computer-Assisted Instructions. Descriptive statistics confirmed that the posttest scores are 10.08 and 9.69with mean difference of 0.39 by male and female students respectively. This showed that the level of Science Process Skill acquired by both male and female students taught Basic Science concept using Computer-Assisted Instruction was almost the same.

Research Question Six: What is the mean difference in the level of Retention between male and female Students taught Basic Science using Computer-Assisted Instructions?

To answer this research question descriptive statistics of mean and standard deviation was used. The post posttest scores of the Experimental group was used to analyze the level of retention between male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.06

Table 4.06: Mean Score for Retention between Male and Female Students in Experimental Group

Groups	N	Mean	Std. Dev	M D
Male	50	29.64	5.49	
				0.39
Female	50	29.34	5.08	

Table 4.06 showed there was no difference in the level of retention between male and female students taught Basic Science concept using Computer-Assisted Instructions. The computed mean scores of Retention were 29.64 and 29.34 for male and female Students. The mean difference of 0.39 is in favour of the male students, even though this difference was not significant.

4.3 Hypotheses Testing

Null Hypothesis One: There is no significant difference in the level of performance between students taught Basic Science using Computer-Assisted Instruction and those taught using Lecture method.

To test this hypothesis, inferential statistical tool of t-test was used. The posttest mean scores of BSAT for both experimental and control groups were computed. The summary of the finding is seen in Table 4.07

Table 4.07: t-test Analysis of Posttest Mean Score of BSAT for Experimental and Control Groups

Group	N	Mean	SD	Df	P-value	Remark
Experimental	100	24.28	4.18	198	0.00	Sig
Control	100	12.51	2.12			

Significant at $p \leq 0.05$ level

Table 4.07 showed that the t = 19.86 and p-value = 0.00 at degree of freedom (df) 198. Since the p-value 0.00 at ≤ 0.05. It means that there is significant difference in the mean scores of the Experimental and Control groups. The significant difference is in favour of the Experimental group exposed Computer-Assisted Instruction. Therefore, null hypothesis one was rejected.

Null Hypothesis Two: There is no significant difference in the acquisition of Science Process Skills of students taught Basic Science using Computer-Assisted Instructions and those taught using Lecture Method.

To test this hypothesis, inferential statistical tool of t-test was used. The posttest mean scores of PSAT for both experimental and control groups were computed. The summary of the finding is seen in Table 4.08

Table 4.08: t-test Analysis of Posttest Mean Score of PSAT for Experimental and Control Groups

Group	N	Mean	SD	Df	P-value	Remark
Experimental	100	23.71	4.71	198	0.001	Sig.
Control	100	10.06	2.21			

Table 4.08 showed that the p = 0.001 at degree of freedom (df) 198 which indicates that there was a significant difference in the mean score of the experimental and control groups. The significant difference is in favour of the experimental group. With this result, null hypothesis two was therefore rejected.

Null Hypothesis Three: There is no significant difference in the level of Retention between Students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method

To test this hypothesis, inferential statistical tool of t-test was used. The post posttest mean scores of BSPT for both experimental and control groups were computed. The summary of the finding is seen in Table 4.09

Table 4.09: t-test Analysis of Post Posttest Mean Score for Experimental and Control Groups

Groups	N	Mean	SD	Df	P-value	Remark
Experimental	100	29.49	5.27			
				198	0.000	Sig.
Control	100	12.72	3.45			

Table 4.09 showed that there was a significant difference in the level of retention between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method. Reasons being that the calculated p-level of 0.00 is lower than the 0.05 alpha level of significance at df 198. Their computed mean Retention are 29.49 and 12.72 by students taught Basic Science using Computer-Assisted Instruction and those taught using Lecture Method. The result is in favour of the experimental groups. Therefore, the null hypothesis three was rejected.

Null Hypothesis Four: There is no significant in the level of Performance between Male and Female students taught Basic Science using Computer Assisted Instructions.

To test this hypothesis, inferential statistical tool of t-test was used. The posttest scores of BSPT for the Experimental group was used to analyze the level of performance between

male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.10

Table 4.10: t-test Analysis of Posttest Mean Score of BSPT for Experimental Group

Group	N	Mean	SD	Df	P-value	Remark
Males	50	25.14	4.71	198	0.127	Not sig
Females	50	25.50	4.82			

Table 4.10 showed that the p-value is 0.127, which is greater than alpha $\alpha \leq 0.05$ with degree of freedom (df) = 198. This means that there was no significant difference between the posttest scores of male and female students exposed to Computer-Assisted Instruction. Therefore, null hypothesis three was retained.

Null Hypothesis Five: There is no significant difference in the level of process Skills acquired between Male and Female students taught Basic Science using Computer- Assisted Instruction

To test this hypothesis, inferential statistical tool of t-test was used. The posttest scores of PSAT of the Experimental group was used to analyze the level of Science Process Skills acquired between male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.11

Table 4.11: t-test Analysis of PSAT Scores between Male and Female Students in the Experimental Group

Group	N	Mean	SD	Df	P-value	Remark
Males	50	22.14	4.31	198	0.126	Not sig
Females	50	22.50	4.38			

Table 4.11 showed that the p value was 0.126, which is greater than alpha $\alpha \leq 0.05$ with degree of freedom (df) = 198. This means that there was no significant difference between the posttest scores of male and female students exposed to Computer-Assisted Instruction. Therefore, null hypothesis three was retained.

Null Hypothesis Six: There is no significant difference in the level of retention between male and female students taught Basic Science using Assisted Instructions.

To test this hypothesis, inferential statistical tool of t-test was used. The post-posttest scores of BSAT of the Experimental group was used to analyze the level of Science Process Skills acquired between male and female students taught Basic Science concept using Computer-Assisted Instruction. The summary of the findings is seen in Table 4.12

Table 4.12: t-test Analysis of BSAT for the Level of Retention between Male and Female Students in the Experimental Group

Groups	N	Mean	SD	Df	p-value	Remark
Male	50	29.64	5.50			
				198	0.78	Not Sig.
Female	50	29.34	5.08			

Table 4.12 showed that there was no significant differences in the level of retention between male and female students taught Basic Science concept using Computer-Assisted Instructions. Reasons being that the calculated p-value of 0.78 is higher than the 0.05 alpha level of significance and the computed t value of 0.28 at df 198. The computed mean of Retention are 29.64 and 29.34 by male and female Students taught Basic Science concept using Computer-Assisted Instruction in favour of the males, in spite of the fact that the difference was not significant, null hypothesis six was retained.

4.4 Summary of Major Findings

Based on the outcome of the analysis, showed that CAI is effective in improving students performance. The following are the major findings of the study

1. Significant difference existed between the level of performance between Students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method. Therefore, null hypothesis one was rejected.
2. Significant difference existed between the acquisition of Science Process Skills of students taught Basic Science concept using Computer-Assisted Instructions and those taught using lecture method. Therefore, null hypothesis two was rejected.
3. Significant difference existed between the level of retention between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture Method. Therefore, null hypothesis three was rejected.
4. There was no significant difference between the level of performance between male and female students taught Basic Science concept using Computer-Assisted Instructions. Therefore, null hypothesis four was retained.
5. There was no significant difference between the level of Process Skills scores acquired between male and female students taught Basic Science using Computer-Assisted Instructions. Therefore, null hypothesis five was retained.
6. There was no significant difference between the level of retention between male and female students taught Basic Science using Computer-Assisted Instructions. Therefore, null hypothesis six was retained.

4.5 Discussion of Results

In this study, the researcher tested the effect of Computer-Assisted Instruction (CAI) on Acquisition of Process Skills, Retention and Performance among Basic Science Students in Kano, Nigeria. To achieve this aim, students in the Experimental Groups were taught

pollution concepts using Computer-Assisted Instruction while students in the Control Group were taught same concept using Lecture Method. Therefore, the observed differences in the results were due to treatment. The results of data analysis were hereby discussed.

The findings of this study showed that significant difference existed in the level of Performance between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture method. This finding is in agreement with Nwafor, (2014) who investigated on the relative effects of Synchronized Multimedia on the Academic Performance and Motivation of Senior Secondary School Biology Students in Port Harcourt, Nigeria. The result showed that students that were taught Biology using Synchronized Multimedia performed significantly better than those taught using lecture method only. Also the finding this study contradicted with the finding of Putman, S. (2010) who conducted a similar research in Northern Ohio, U.S.A. The study investigated the effect of teaching English Language, Arts, and Mathematics using Power Point Presentation (PPP). The finding revealed that there was no significant difference in students' performance among those taught using PPP and those taught using lecture method.

The findings of the present study showed that significant difference existed between the acquisition of Science Process Skills of students taught Basic Science using Computer-Assisted Instructions and those taught using lecture method in favour of experimental group. This finding is in agreement with Bork (2013) whose findings showed that students that used Personalized System of Instruction (PSI) using computer as teaching aid had significantly acquired the Science Process Skills better, due to interaction with computers. Also the finding of Hui (2007) who conducted a research study on Computer-Assisted Instruction (CAI) to test the effectiveness and satisfaction in language learning at

a major University in Hong Kong. Their finding revealed that the use of CAI had helped the students to recall the concepts being learned and showed improved performance. The research proved that Computer-Assisted Instruction supports vocabulary learning better than the lecture method. Neuman, Neuman and Hood (2011) also examined whether the use of computer has an effect on students' participation during lesson in elementary schools in the sub-urban area in the United States of America. The finding showed that the use of the computers in the classroom had encouraged students' participation during learning, which is an indication of Process Skills Acquisition. The finding of this study contradicted with the finding of Suwaid (2013) who conducted a study on Technology-Assisted Learning as a potential for the acquisition of basic science process skills and ICT skills by school children. The study revealed that there was no significant difference in the performance of children exposed to TAL and those that were not. Impliedly it proved that association with games (simple technology tools) has no effect on students' performance.

The findings of the present study showed that significant difference existed in the level of retention between students taught Basic Science using Computer-Assisted Instruction and those taught using Lecture Method. This finding is in agreement with the finding of Christian (2007) who investigated on the effect of the use of interactive multimedia board on student's perception among Grade Nine Science Students in Caucasia Sophomores (U.S.A). The findings proved that students found the use of Interactive Multimedia Board more interesting, and showed improved Retention and Performance. Thomas and Stocton (2010) who investigated the impact of Computer-Assisted Instruction on gender, retention and academic achievement among secondary school students found that CAI is not gender friendly. The result of the finding indicated that there is higher retention among female students.

The findings of this study showed that there was no significant difference in the level of performance between male and female students taught Basic Science concept using Computer-Assisted Instructions. The finding is in agreement with Abu (2008) who conducted a study to investigate the effectiveness of Computer-based Science Simulations and Lecture Methods on performance in Biology among Senior Secondary School Students. The result showed that subjects taught with Computer-based Science Simulations Instruction performed better in Science, than those taught using the Lecture Method. This also agrees with the work of Bichi (2002), Aweriale (2006) which showed no significant difference between male and female achievement in science. This result shows that Computer-Assisted Instruction is gender friendly. The finding of Belal (2011) who conducted a research on students' perceptions on computer-assisted learning at the Ashton Business School, Aston University Birmingham contradicted with the finding of the present study as the interviewers rejected the idea of replacing human tutors with machines and they believed that most of their learning occurs in tutorials. It was therefore recommended that CAI should be used in business schools.

The findings of the present study showed that there was no significant difference in the level of Science Process Skills Acquisition between male and female students taught Basic Science concept using Computer- Assisted Instructions. The finding is in agreement with Chukwuka, (2009) who conducted a study on Students' Perception on Computer-Simulation usage to teach concepts of evolution in Biology among NCE Students of Federal College of Education Ibadan, Oyo State, Nigeria. Results of the findings revealed that NCE Students have positive Perception of Computer-Simulation usage in Biology and it is gender friendly.

The findings of the present study showed that there was no significant difference in the level of retention between male and female students taught Basic Science concept using

Computer-Assisted Instructions. This finding contradicted with the findings of Thomas and Stocton (2010) who investigated the impact of Computer-Assisted Instruction on gender, retention and academic achievement among secondary school students found that CAI is not gender friendly. The result of the finding indicated that there is higher retention among female students. Similarly, the finding agree with the work of Geddes and Goraset (2010) whose investigation on the effect of Technology-Assisted Instruction on students' gender and retention ability among Senior Secondary School Biology students in Uganda, revealed that Technology-Assisted Instruction enhances retention and is gender friendly.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study determined the Effects of Computer-Assisted Instruction (CAI) on acquisition of Science Process Skills, Retention and Performance among Basic Science Students in Kano, Nigeria. This chapter is discussed under the following sub headings:

5.2 Summary
5.3 Major findings
5.4 Conclusion
5.5 Recommendation
5.6 Limitation
5.7 Contributions to Knowledge
5.8 Suggestions for Further Study

5.2 Summary

The main objective of the study was to find the Effects of Computer-Assisted Instructions on acquisition of Science Process Skill, Retention and Performance among Basic Science Students in Kano Nigeria. Available literature relevant to the study was reviewed. Most of the work concluded that the Computer-Assisted Instruction enhanced acquisition of Science Process Skill and academic performance.

The research design employed for the study was quasi-experimental involving pretest, posttest and post posttest control and experimental groups. The population of the study consisted of 41 Junior Secondary Schools in Municipal Local Government of Kano State. The size of the population was 8,131. Out of the 41 schools, 22 were males, with a population of 4,870. The remaining nineteen schools were female schools with a population of 3,261. There are no co-educational schools among the Government Junior Secondary Schools in the population. Four schools were selected for the study because they were found to be equivalent in their pretest scores. The sample of the study was 200

students. Intact classes of JSS II were picked out of the arms in the schools using simple random sampling (balloting technique) because they were found to be equivalent. The schools were divided into the Experimental and the Control groups respectively.

Two instruments were used for data collection. These instruments are: Basic Science Performance Test (BSPT) and Process Skills Acquisition Test (PSAT). BSPT was adapted from the Junior Secondary School Certificate Examination (JSCE, 2009-2014), which contained 40 structured multiple choice items with one correct answer and three distracters for each set. The test items covered all the concepts taught under pollution. PSAT was adapted from Usman (2014) to test the level of science process skills acquired based on the various pollution concepts taught. The instruments were used to measure students' retention, performance and science process skills acquisition among Basic Science students under study. The experimental groups were taught using CAI while the control groups were taught using the lecture method.

The data collected were analyzed using t-test to test the six hypotheses formulated. The results and discussions were presented in chapter four. A confidence limit of 0.05 level of significance was adopted for retaining or rejecting the hypotheses.

5.3 Major Findings

The following are the major findings of the study:

1. Significant difference existed in the level of performance between students taught Basic Science concept using Computer-Assisted Instruction and those taught using Lecture method. The result showed that the scores of the experimental group was significantly higher than that of the control group.
2. Significant difference existed in the acquisition of Science Process Skills between students taught Basic Science concept using Computer-Assisted Instructions and those taught using the lecture method, in favour of the experimental group.

3. Significant differences existed in the level of Retention ability between students taught Basic Science using Computer-Assisted Instruction and those taught using Lecture Method. The retention ability was higher in the experimental group.
4. There was no significant difference in the level of performance between male and female students taught Basic Science concept using Computer-Assisted Instructions. This showed that both male and female students have almost the same performance when taught using Computer-Assisted Instruction.
5. There was no significant difference in the level of process skills acquired among male and female students taught Basic Science concept using Computer -Assisted Instructions. This showed that both males and females have equally acquired the same process skills when taught using Computer-Assisted Instruction.
6. There was no significant difference in the level of retention ability between male and female students taught Basic Science concept using Computer-Assisted Instructions. The retention ability of male students was slightly higher than that of their female counterparts.

5.4 Conclusions

On the basis of the study findings, the use of CAI has brought an impact on the acquisition of science process skill, retention and performance among Basic Science students. Therefore, the following conclusions were reached:

1. There was a significant increase in the level of Science Process skill acquisition among Basic Science students taught Pollution concepts due to the exposure to Computer-Assisted Instructions than those taught the same concepts using the Lecture Method.

2. The use of the Computer-Assisted Instruction has increased the overall performance of students especially when pre test and post test scores were compared.
3. Students who were exposed to the Computer-Assisted Instruction have higher retention ability when compared with those exposed to the lecture method.
4. The score difference of males and females was negligible. This showed that both male and female students have almost the same performance which indicated the effectiveness of Computer-Assisted Instruction as a method of teaching that is gender friendly.
5. Both male and female students have acquired the same level of science process skills based on their scores. This showed that the Computer-Assisted Instruction provided the same positive effect for both male and female students.
6. Male and female students have the same retention ability when taught pollution concepts in Basic Science using Computer-Assisted Instructions

5.5 Recommendations

The following recommendations were made by the researcher:

1. Basic Science teachers in Junior Secondary Schools in Kano State should be encouraged to use the Computer-Assisted Instructions in teaching some concepts in Basic Science like the pollution concept, as it improves performance and enhances the acquisition of science process skills.
2. The State Ministry of Education should provide adequate Information Technology equipment such as computers and software, which are the basic equipment needed for the implementation of Computer-Assisted Instruction as a method of teaching.
3. Both male and female students should be equally exposed to Computer-Assisted Instructions by science teachers, as an effective modern teaching technique for

improvement of academic performance, retention and science process skills acquisition

4. Both the State and the Federal Government should organize workshops, seminars and talk shows for Basic Science teachers on how to use Computer-Assisted Instruction in the teaching and learning process.
5. The knowledge of CAI should be a prerequisite for the enrollment of students into Senior Secondary School by the State ministry of education.
6. Male and female students should be given equal opportunity to use CAI at all levels, as it is gender friendly.

5.6 Limitations

The following limitations were encountered in the conduct of this study:

1. There were no computers in the study area therefore the researcher was imposed with the difficulty of finding the computers that were used.
2. In addition to the lack of computers, there was no power supply in most of the schools at the time of study hence a generator had to be used.
3. Only four Junior Secondary Schools in the study area were sampled and used which limits the scope of generalization.
4. Students used for this study were not familiar with Computer-Assisted Instruction therefore; time was spent on explaining, clarifying, and involving them in the process of learning.
5. The concept used for this study was Pollution. If a different concept such as evolution or genetic was used, different results might have been obtained.

5.7 Contributions to Knowledge

This study, "Effects of Computer-Assisted Instruction (CAI) on acquisition of Science Process Skills, Retention and Performance among Basic Science Students in Kano,

Nigeria" has contributed to knowledge in Science Education and other areas in the following ways:

1. The researcher adapted Basic Science Performance Test (BSPT) and measured Students, Retention level in Pollution concepts, which was a new approach in the teaching of Basic Science among Nigerian Schools.
2. The introduction of "Process Skills as a Part of Scientific Investigation Model" adapted from UNESCO (1992) has shown an improvement in the Acquisition of Science Process Skill among Basic Science Students, which is relatively new to the Basic Science Teachers in the study area.
3. The instruments used by the researcher in carrying out the study were found efficacious in assessing the effects of CAI on Students' Academic Performance, Retention and Acquisition of Science Process Skill.
4. The finding of this study has added new knowledge in the teaching of science as the use of CAI, flow chart and lesson plan were added to existing body of knowledge.

5.8 Suggestions for Further Studies

i. In order to increase the scope of generalization, the study should be replicated in other Junior Secondary School in Nigeria.

ii. There is the need to study the impact of CAI in Private schools, Federal Govt. schools with a group of students from privileged background and average income homes to see whether the same or better results will emerge.

iii. Since the use of CAI has been established as a strategy that brings about improved Retention and Performance then its effects should be investigated in other subjects in the Basic Education System.

iv. Similar studies should be conducted on the impact of CAI on the academic Performance and Interest among Junior Secondary Schools in North Western states of Nigeria.

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APPENDIX 1
BASIC SCIENCE PERFORMANCE TEST (BSPT)

Instruction: Answer all questions

Time allowed: 1hour

1. Define the term pollution
   a) Contamination of the environment
   b) Beautification of the environment
   c) Precipitation of the environment
   d) 135Cultivation of the environment

2. Identify any one of the following that can be considered as one of the consequences of pollution
   a) Poverty
   b) Famine
   c) Hunger
   d) Many deceases

3. Explain in not more than two words the concept of "Contamination of the atmospheric air"
   a) Environmental pollution
   b) Land pollution
   c) Air pollution
   d) Noise pollution

4. Describe the term water pollution
   a) A change in the natural characteristics of water
   b) A change in the constituents of water
   c) A change in the chemical formular of water
   d) A change in the definition of water

5. Distinguish any one of the following that does not constitute a type of pollution
   a) Rocks pollution
   b) Land pollution
   c) Water pollution
   d) Air pollution

6. Describe the term atmosphere.
   a) The life blanket of the earth
   b) The structure of the earth
   c) The component of the earth
   d) The structure of the earth

7. Identify any one of the following that may not be an agent of air pollution
    a) Harmful dust
    b) Harmful gases
    c) Oil spillage
    d) Exhaust from automobiles

8. Identify one source of air pollution among the following
    a) Schools
    b) Domestic fuels
    c) Air conditioners
    d) Wind

9. Distinguish any one of the following gases that cannot be associated with air pollution
    a) Oxygen
    b) Carbon monoxide
    c) Sulphur dioxide
    d) Smoke

10. Predict any one of the following that can help to prevent air pollution
    a) The use of natural gas in auto vehicles
    b) The use of fire wood at home
    c) Exhaust from vehicles
    d) Discharge of gases from industries

11. Any physical, chemical, or biological change in the quality of water that adversely affects its use by living organisms can be termed as…
    a) Air pollution
    b) Water pollution
    c) Environmental degradation
    d) Biological change

12. Identify any one factor that causes diseases like cholera and typhoid fever are mostly caused by the use of
    a) Use of polluted water
    b) Use of sandy water
    c) Use of rocky water
    d) Use of warm water

13. Predict the possible consequences of washing cloth or vehicles in rivers
    a) Add nutrients to the water
    b) Reduces salt level in the water
    c) Decreases pollution
    d) Pollutes the water

14. Predict what happens when oil from an industry is discharged into a body of water containing aquatic animals
    a) Reduces water pollution
    b) Causes water pollution
    c) Kills aquatic animals
    d) Feeds aquatic animals

15. Identify one of the major habitats of terrestrial organisms.
    a) The space
    b) The land
    c) The roof
    d) The atmosphere

16. Describe what happens as a result of mining, quarrying and erosion
    a) Beautification of the earth
    b) Help plants to grow
    c) Causes land pollution
    d) Causes urbanization

17. Point out any one factor that is not an agent of land pollution
    a) Planting
    b) Deforestation
    c) Forest fires
    d) Industrial waste

18. A polluted land can be described as…
    a) Good for garden
    b) Good for building
    c) Not good for planting
    d) Good for rearing animals

19. Identify any one major cause of death in land animals
    a) Sunlight
    b) Rainfall
    c) Land pollution
    d) Cold weather

20. Application of the process of tree planting has the tendency to
    a) Kill animals
    b) Make the environment cold
    c) increases land pollution
    d) Reduces land pollution

21. Identify any one process that cannot be used as a preventive measure of land pollution
    a) More farming
    b) More tree planting
    c) Proper waste disposal
    d) Uncontrolled land treatment

22. Relate the emission of gases from industries to any one of the following pollution types
    a) Causes air pollution
    b) Causes water pollution
    c) Causes noise pollution
    d) Causes radioactive pollution

23. Identify any major consequence of Spilling oil in oceans
    a) Causes water pollution
    b) Causes air pollution
    c) Results to environmental pollution
    d) Results to noise pollution

24. Identify any one factor that cannot be considered as an agent of water pollution
    a) Oil spill from industries
    b) Dumping plastics in rivers
    c) Discharge of pesticides into rivers
    d) Presence of water plants

25. Applying the concept of afforestation and re-forestation can helps to prevent….
    a) Water Pollution
    b) Noise pollution
    c) Air pollution
    d) Land/soil pollution

26. Identify any one of the following illnesses that can be caused by air pollution cause
    a) Respiratory illnesses
    b) Tooth ache
    c) Headache
    d) Heart attack

27. Point out one effect of water pollution
    a) Kills insects
    b) Kills flying birds
    c) Destroys the quality of water
    d) Kills terrestrial animals

28. Among the following identify any one characteristics of a polluted land
    a) Polluted land is good for planting
    b) Polluted land is bad for planting
    c) Looks beautiful
    d) Polluted land is ideal for rearing animals

29. Applying the knowledge of the concept of pollution to everyday life
    a) Causes pollution
    b) Increases the rate of pollution
    c) Decreases the rate of pollution
    d) Is dangerous for human beings

30. Point out any one of the following that is not among the 3Rs principles
    a) Reduce
    b) Re-use
    c) Re-cycle
    d) Tri-cycle

31. Discriminate among the following gases any one that is not a constituent of safe air
    a) Oxygen
    b) Nitrogen
    c) Carbon dioxide
    d) Carbon monoxide

32. Describe the term pollution
    a) Pollution can be describe as the component of the environment
    b) Pollution can be describe as the situation of the earth
    c) Pollution can be describe as some form of environmental hazard
    d) Nature of the earth

33. What is the major cause of pollution in developing countries?
    a) Un checked industrialization
    b) Slow industrialization
    c) Afforestation
    d) Harmonization

34. Select any one type of pollution that can be control through the use liquefied natural gas
    a) Land pollution
    b) Noise pollution
    c) Water pollution
    d) Air pollution

35. Predict the effects of the pouring paints and oils into water channels
    a) Can help in water purification
    b) In making the water look colourful
    c) In making the water to become polluted
    d) In making the water to smell like paint

36. Distinguish any one of the following that is not a gaseous pollutant
    a) Garbage
    b) Ammonia
    c) Smoke
    d) Carbon monoxide

37. Application of the knowledge of filtration can be used as the first step that can be used to purify…
    a) Polluted land
    b) Polluted rock
    c) Polluted water
    d) Polluted soil

38. Identify any one strategy that can be used as a control measure of air pollution
    a) Buying so many cars
    b) Encourage the use public transport
    c) Use of old cars
    d) Use of motor bikes

39. Point out any one of the following consequences that may not be an effect of land pollution
    a) Causes damage to houses
    b) Destroy lives
    c) Increases the fertility of the soil
    d) Make soil to be infertile

40. Give an inference of what will happen when garbage is being dumped into a river
    a) Help to filter the water
    b) Enrich the quality of water
    c) Reduce the quantity of water
    d) Causes pollution of the water.

APPENDIX 2
MARKING SCHEME FOR BASIC SCIENCE PERFORMANCE TEST (BSPT)

Instruction: Answer all questions

Time Allowed: 30minutes

Marks allocation: One mark for each question answered correctly

Total marks: forty (40)

1	A	6	C	12. D	19. C	25. D	31. D	37. C
2	D	7	B	13. C	20. D	26. D	32. C	38. B
3	C	8	A	15. B	21. D	27. C	33. A	39. C
4	A	9	A	16. C	22. A	28. B	34. D	40. D
5	A	10	B	17. C	23. A	29. C	35. C	
6	A	11	A	18. C	24. A	30. D	36. A	

APPENDIX 3

PROCESS SKILLS ACQUISITION TEST

Instruction: Answer all questions

Time allowed: One hour

This instrument is meant to measure the level of process skills acquisition among junior secondary school students in Kano Metropolis**.**

Section A: Personal Data

Name:…….

School:……

Age:……..

Group:…….

Section B: Read the Instructions and answer all questions that follows in the space provided

EXPERIMENT ONE

Pour a gallon of kerosene into the tank of water provided

Q1.**Observe**any change that has occurred in the appearance of the water

Q2. **Write out** your findings

Q3. **Explain** on the situation in section B above

Q4. Based on the experiment (experiment 1) **deduce** the agent of pollution in this case

Q5. Based on your inference **predict** any 2 consequences of the above situation

EXPERIMENT TWO

Collect and dispose all the refuse in the school into the school well.

After some minutes, tie a rope to a bucket and draw out water from the well.

Then collect some water from the tap in another container

Q1. **Observe** the quality of the water drawn from the well and the water fetched from the tap

Q2. **Classify** the quality of the water drawn from the well to the quality of the water fetched from the tap

Q3. From your observation **suggest** two possible ways of preventing water pollution

Q4. **Predict** any two possible consequences of using polluted water for domestic use

Q5. From you **observation** enumerate two qualities of the tap water (clean water)

EXPERIMENT THREE

Collect all the refuse around the school and set fire to it.

Allow it to burn completely, and then answer the following questions

Q1**.Observe** and record your observation

Q2.**Write out** what happened as a result of the burning that occurred

Q3.**Compare** the outcome of experiment (2) and (3)

Q4.**Explain** on the possible health consequences of the two types of pollution

Q5. **Outline** two possible ways of controlling air pollution

EXPERIMENT FOUR

Collect a reasonable amount of kerosene and pour it out into one section of the school garden.

Repeat the action for one week. Then answer the questions that follow

Q1**. Observe** the physical changes that occurred to the plants and the earth

Q2. Give an **explanation** on your findings

Q3**.**From your **observations, predict** on the consequences that may occur

Q4. From your observation and analysis suggest measures that could be used to control land pollution.

Q5. Apart from kerosene **list** two other causative agents of land pollution

APPENDIX 4
MARKING SCHEME FOR PROCESS SKILLS ACQUISITION TEST

Marks allocation: One mark will be awarded for each point raised correctly

EXPERIMENT ONE

Q1. Expected answer (1 mark)

i. The water in the tank has become oily

Q2. Expected answer (1 mark)

i. The water has been rendered polluted

Q3. Expected Answers (1 mark for any two correct points)

i. The kerosene has rendered the water unhealthy

ii. The smell of the water has changed

iii. The colour of the water has changed

Q4. Expected answer (1 mark)

i. The kerosene that was mixed with the water is the agent of pollution

Q5. Expected answer (1 mark for any two points)

i. Air cannot penetrate into the water

ii. The water cannot be used for consumption

iii. The water cannot be used for cleaning

iv. The tank water cannot be used as a fish pond

EXPERIMENT TWO

Q1. Expected answers (1 mark)

i. The water drawn from the well looks dirty

ii. The water fetched from the tap look clearer

Q2. Expected answers (1 mark for any two points)

i. The water drawn from the well looked dirty while the water fetched from the tap look clearer

ii. The water from the well smells bad while the water from the tap has no smell

iii. The water from the well will not be good for consumption while the water from the tap can be consume

Q3. Expected answers (1 mark)

i. Water pollution can be controlled by not disposing industrial or domestic waste into body of water.

ii. By not washing cloth or bathing animals in rivers or any body of water

Q4. Expected answers (1 mark)

i. Some of the possible effects of water pollution is that it can cause illnesses like cholera, diarrhea and typhoid fever.

ii. Water pollution can kill aquatic animals.

Q5. Expected answer (1 mark)

i. The tap water is colourles

ii. Odourless and

iii. tasteless

EXPERIMENT THREE

Q1. Expected answers (1 mark for any two points)

i. There was an evolution of smoke

ii. The atmosphere has become blurry to the vision

iii. The smell of the surrounding air has also become unpleasant

iv. The residue has become completely black

v. The ground surface too has become black

Q2. Expected answers (1 mark)

i. The smoke has indicated that the atmospheric air has become polluted

ii. The land where the burning took place also has become polluted

Q3. Expected answers (1 mark)

i. Instruction two has shown an incidence of water pollution

ii. Instruction three has shown an incidence of air pollution

Q4. Expected answers **(1mark)**

i. Drinking polluted water causes diseases, such as cholera, diarrhea, skin infections and typhoid fever

ii. Respiring polluted air causes respiratory illnesses like asthma, sinuses and the like.

Q5. Expected answers (1 mark)

i. Avoid burning of refuse in an open space

ii. Avoid the use of fire wood and kerosene stove

EXPERIMENT FOUR

Q1. Expected answers (1 mark for any two points)

i. The colour of the soil has changed

ii. The texture also has changed

iii. The smell too has changed

Q2. Expected answer (1 mark)

i. The plants were destroyed because the earth has become polluted

Q3. Expected answers (1 mark for any two points)

i. The soil may not support farming for sometime

ii. The nutrients of the soil may have been destroyed by the kerosene

iii. The inhabitants of the soil e.g. earth worms might also have been killed

Q4. Expected answers (1 mark)

i. Land pollution can be controlled by planting trees everywhere

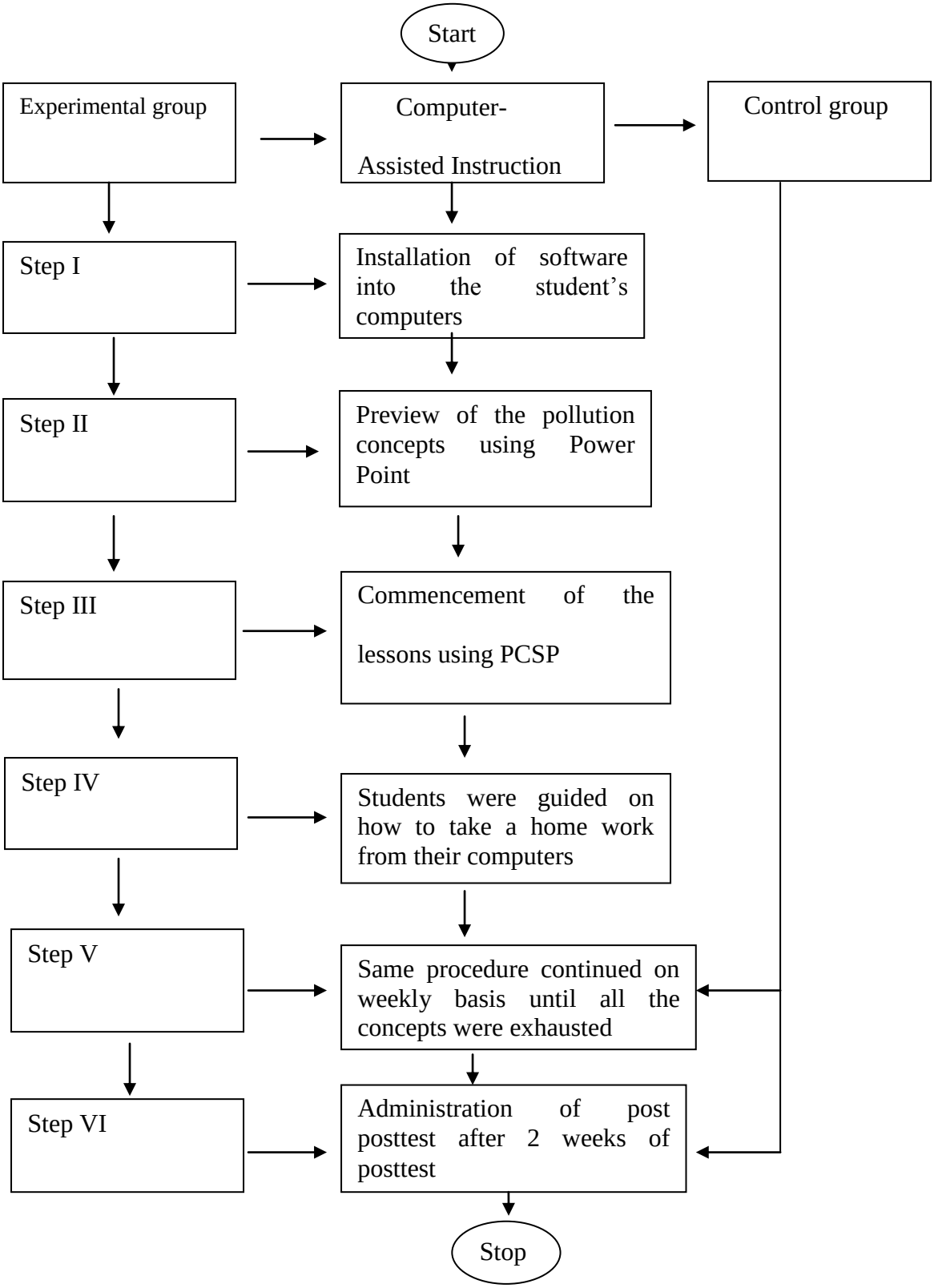
ii. Land pollution can also be control by not dumping refuse or industrial waste on the ground surface

Q5. Expected answers (1 mark)

i. House hold garbage

ii. Burning open dumps and forest fires

APPENDIX 5



Flow chart: Adapted from Fred (2007) illustrating steps in CAI

APPENDIX 6
LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK ONE

Name of School: Rumfa College Kano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Environmental Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age of Student: Twelve to Fourteen Years

Teaching Resources: Computer, Projector and a personalized computer soft ware package

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. explain clearly the concept of environmental pollution
ii. define the term Pollution
iii. outline at least five practices that causes environmental pollution

Previous Knowledge: Students are aware of the discomfort of having smoke and garbage around their houses.

Introduction: The teacher will introduce the lesson by showing a preview on environmental pollution using power point presentation

Presentation

The lesson will be presented in the following steps:

Step One: The teacher will show a preview of the lesson on pollution concept using a power point presentation.

Step Two: The students will be instructed to observe the various pictures showing scenes of environmental pollution from a Personalized Computer Soft Ware Package (PCSWP) installed into their computers.

Step Three: From the observation being made, the students will be asked to briefly explain or define the concept of pollution according to their own understanding.

Step Four: The students will be instructed to show different pictures that clearly indicates incidence of environmental pollution

Evaluation: The teacher will evaluate the lesson in the following ways:-

i. Ask the students to project their findings based on their observation.
ii. Ask the students the following questions.

1. What is pollution?

Expected answer

The presence of unwanted elements that can cause adverse effects to the environment as well as the inhabitants of the environment is termed as pollution

Home work

i. Define and explain the concept of environmental pollution

ii. Outline five home practices that causes pollution

LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK TWO

Name of School: Rumfa College Kano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Types of Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age of Student: Twelve to Fourteen Years

Teaching Resources: Computer, Projector and a personalized computer soft ware package

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. define the term Pollution

ii. identify different Types of Pollution from the PCSWP

iii. explain three (3) common types of Pollution

Previous Knowledge: Students are aware of the discomfort of having smoke and garbage around their houses.

Introduction: The teacher will introduce the lesson by showing a preview on environmental pollution using power point presentation

Presentation: The lesson will be presented in the following steps:

Step One: The teacher will show a preview of the lesson on pollution concept using a power point presentation.

Step Two: The students will be instructed to observe the various pictures showing scenes of environmental pollution from a Personalized Computer Soft Ware Package (PCSWP) installed into their computers.

Step Three: From the observation being made, the students will be asked to briefly explain or define the concept of pollution according to their own understanding.

Step Four: The students will be allowed to proceed to the next step to classify pollution into different types, and try to explain each type.

Evaluation: The teacher will evaluate the lesson in the following ways:-

i. Ask the students to project their findings based on their observation.

ii. Ask the students the following questions.

1. What is pollution?

Expected answer

The presence of unwanted elements in our environment is termed as pollution

2. Name and define the three types of pollution

Expected answer

The three types of pollution are:

3. Air pollution

When the atmospheric air becomes contaminated with harmful gases or dust particles we say that the air is polluted.

- Water Pollution

Any physical, chemical, or biological change that affects the quality of water and renders the water as unfit for consumption is termed as water pollution.

- Land Pollution

Land pollution on the other hand is referred as the destruction or damage of the earth surface as a result of human activities.

Home work

The students will be ask to answer the same questions as take home assignment

LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK THREE

Name of School: Rumfa College Kano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Air Pollution, causes, effects and control measures.

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Computers, Projector, Personalized Computer soft ware package

Behavioral Objectives: By the end of the lesson, the students should be able to:

i. project the correct definition of air pollution
ii. outline three (3) causes of air pollution
iii. outline two (2) effects of air pollution
iv. Outline and show with the aid of the personalized computer software package three ways by which air pollution can be controlled.

Previous Knowledge: Students have learnt about the concept of pollution and types of pollution

Introduction: The teacher will instruct the students to identify and carefully observe a scene of gas emissions from industries with the aid of the PCSWP installed in their computers.

Presentation: The lesson will be presented in steps in the following way:-

Step One: The teacher will show a preview of some pictures of air pollution using power point presentation

Step Two: The students will be instructed and guided to observe a scene of gas emissions from industries and automobiles on their computers and then use their observation to briefly explain or define air pollution.

Step Three: From the Personalized Computer Software Package (PCSWP) the students should be guided to observe and explain some of the causes and effects of air pollution. The students will then be guided to move to the next stage where some of the causes and effects of pollution are being enumerated.

Step Four: The teacher will instruct the students to further interface with their computers and find out some control measures of air pollution, and then move to the next stage where some of the control measures of air pollution are being enumerated.

Evaluation: The teacher will evaluate the lesson in the following way:-

i. Ask the students to write down their findings from the observations they made.

ii. The teacher will ask the students the following questions:-

1. Define air pollution

Expected answer

The contamination of the atmospheric air with harmful gases and dust particles is termed as air pollution

2. List out two causes and two effects of air pollution

Expected answer

The two causes of air pollution include the following:-

i. Emission of gases from industries into the atmosphere

ii. Emission of gases from auto mobiles

The two effects of air pollution are as follows:-

i. Air pollution affects the health of living organisms by causing illnesses like cholera, typhoid fever, and asthma

ii. Air pollution affects the environment in general by causing global warming.

Home work

The teacher will give the following question as take home assignment

i. Outline two control measures of air pollution

Expected answer

The two control measures of air pollution are as follows:-

Expected answer

The control measures of air pollution include:-

i. The use of natural gas like the liquefied petroleum gas

ii. The use of electrical stove rather than kerosene stoves

LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK FOUR

Name of School: Rumfa College Kano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Water pollution, causes, effects and control measures.

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Computers, Projector, Personalized Computer Soft Ware Package

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. define water pollution
ii. list three (3) causes of water pollution
iii. state two (2) effects of water pollution
iv. with the aid of PCSWP show three ways by which water pollution can be controlled.

Previous Knowledge: Students have learnt about air pollution

Introduction: The teacher will instruct the students to carefully observe a scene of oil spill from an industry and various pictures of water pollution with the aid of the PCSWP installed in their computers.

Presentation: The lesson will be presented in steps in the following way:

Step One: The teacher will show a preview of water pollution using a power point presentation

Step Two: The teacher will instruct the students to observe and explain water pollution from the PCSWP. The students will then be instructed to each use their observations to define or explain the concept of water pollution.

Step Three: From the PCSWP the students should observe and enumerate the causes and effects of water pollution.

Step Four: The teacher will instruct the students to further interface with their computers and find out some control measures of water pollution; then the students will be instructed and guided to move to the next stage where some of the control measures of water pollution are being enumerated.

Evaluation: The teacher will evaluate the lesson in the following way:

i. Ask the students to write down their findings.
ii. The teacher will ask the students the following questions:
iii. Define water pollution

Expected answer:

Water pollution can be referred as a change in the biological, chemical, and physical properties of water that alters the quality of water and causes adverse effects to its users.

1. List out two causes and two effects of water pollution

Expected answers:

The following are the two causes of water pollution

i. Discharge of industrial waste into bodies of water
ii. Dumping of refuse or dead bodies into water body

Home work

The following question will be giving to the students as take home assignment

i. State and explain two control measures of water pollution

Expected answer:

The two control measures of water pollution are as follows:

i. Rivers must not be used for dumping refuse
ii. Industrial waste must not be dumped in rivers

LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK FIVE

Name of School: Rumfa CollegeKano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

TOPIC: Land pollution, causes, effects, and control measures.

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Computers, Personalized Computer Soft Ware Package, chalk board and basic science text book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. Write out the definition of land pollution
ii. Identify three (3) causes of land pollution
iii. Explain two (2) effects of land pollution
iv. Outline and show in your computers three ways by which land pollution can be controlled.

Previous Knowledge: Students have learnt about water pollution

Introduction: The teacher will instruct the students to carefully observe a scene of oil spill from industries and various pictures of land pollution with the aid of the PCSWP installed in their computers.

Presentation: The lesson will be presented in steps in the following way:

Step One: A preview of land pollution pictures will be shown by the teacher using a power point presentation

Step Two: The students will be ask to observe a scene of oil spillage from industries on their computers. The teacher will then instruct the students to each use their observations to briefly explain or define land pollution.

Step Three: From the PCSWP the students should be able to observe and enumerate some causes and effects of land pollution. Then they will instruct the students to move to the next stage where some causes and effects of land pollution are being enumerated.

Step Four: The teacher will instruct the students to further interface with their computers and find out some control measures of land pollution. The teacher will further instruct the students to move to the next stage where some of the control measures of land pollution are being enumerated.

Evaluation: The teacher will evaluate the lesson in the following way:-

i. Ask the students to write down their findings.

ii. The teacher will ask the following questions:

iii. Define land pollution

Expected answer:

The destruction and damage of the earth surface as a result of human activities is termed as land pollution.

1. List out two causes and two effects of land pollution

Expected answer:

The two causes of land pollution are as follows:

i. Mining, Erosion and Quarrying

ii. Forest fires and deforestation

The two effects of land pollution are as follows:

i. Polluted land becomes unfit for planting

ii. Land pollution destroys terrestrial habitat and kills the terrestrial inhabitants

Home work

The following question will be giving to the students as take home assignment

1. Write out two control measures of land pollution

Expected answer:

The control measures of land pollution include the following:

i. Planting of trees to prevent erosion

ii. The use of pesticide and fertilizers should be reduced

LESSON PLAN FOR EXPERIMENTAL GROUP

WEEK SIX

Name of School: Rumfa College Kano and Maryam Alooma Mukhtar

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

TOPIC: General overview of Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Computers, Personalized Computer Soft Ware Package, chalk board and basic science text book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. Write out the definition of pollution in general
ii. Identify three (3) different types of pollution that occurs in our environment
iii. Identify one consequence of each type of pollution

Previous Knowledge: Students have learnt about air, water, and land pollution

Introduction: The teacher will instruct the students to carefully observe the various pictures showing environmental pollution from their computers

Presentation: The lesson will be presented in steps in the following way:

Step One: A preview of air, water, and land pollution pictures will be shown by the teacher using a power point presentation

Step Two:

i. The students will be ask to observe a scene of air pollution as a result of industrial activity from their computers.
ii. After clear observation the students should be ask to explain some of the possible consequences of air pollution

Step Three:

i. The students will be ask to observe a scene of water pollution as a result of industrial waste disposal into rivers.
ii. After clear observation the students should be ask to explain some of the possible consequences of water pollution

Step Four:

i. The teacher will instruct the students to further interface with their computers and find out some control measures of water pollution.

ii. The teacher will further instruct the students to move to the next stage where some of the control measures of water pollution are being enumerated.

Step Five:

i. The students will be ask to observe a scene of land pollution as a result of oil spillage from industries

ii. After clear observation the students should be ask to explain some of the possible consequences of land pollution

Step Six:

i. The teacher will instruct the students to further interface with their computers and find out some control measures of land pollution.

ii. The teacher will further instruct the students to move to the next stage where some of the control measures of land pollution are being enumerated.

Evaluation: The teacher will evaluate the lesson in the following way:-

i. Ask the students to write down their findings.

ii. The teacher will ask the students to show a picture of air pollution

iii. List out two causes and two effects of water pollution

Home work

The following question will be giving to the students as take home assignment

1. Write out two control measures of land pollution

Expected answer:

The control measures of land pollution include the following:

i. Planting of trees to prevent erosion

ii. The use of pesticide and fertilizers should be reduced

2. Write out the control measures of water pollution

Expected answered:

i. By not dumping refuse in water bodies

ii. By not bathing or washing vehicles on river banks

iii. By avoiding the discharge of oils from industries into rivers

APPENDIX 7
LESSON PLAN FOR CONTROL GROUP

WEEK ONE

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Concept of environmental Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age Students: Twelve to Fourteen Years

Teaching Resources: Chalk Board and Basic Science Text Book

Behavioural Objectives: by the end of the lesson, the students should be able to:

i. explain clearly the concept of environmental pollution
ii. define the term Pollution
iii. outline at least five practices that causes environmental pollution

Previous Knowledge: Students are aware of the discomfort of having smoke and garbage around their houses.

Introduction: The lesson will be introduced by revising the previous knowledge.

Presentation: The lesson will be presented in the following steps

Step One

i. The teacher will begin by explaining the concept of pollution
ii. Using simple words the teacher will define pollution
iii. The teacher will then write a brief definition on the board and ask the students to copy.

Step Two

i. Students will be taught that pollution can occur any where in the environment by siting examples**.**

Step Three

i. The teacher will then briefly write the definitions of the four types of pollution that can occur in our environment as outlined above.
ii. The teacher will then ask the students to copy the definitions in their note books.

Evaluation

The teacher will evaluate the lesson by asking the following questions:-

i. What is pollution?

Expected answer

The presence of unwanted elements in our environment is termed as pollution

1. Give three examples of places that can be polluted

Expected answer

The possible places where pollution can occur includes the following

i. The atmospheric air

ii. Water bodies

iii. land

Contamination of the atmospheric air with harmful gases or dust particles is termed as air pollution.

i. Water Pollution

Any physical, chemical, or biological change that affects the quality of water and renders the water as unfit for consumption is termed as water pollution.

i. Land pollution

Land pollution signifies the destruction or damage of the earth surface as a result of human activities.

Home work

The students will be asked to answer the same questions as take home assignment.

LESSON PLAN FOR CONTROL GROUP

WEEK TWO

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Types of Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age of Student: Twelve to Fourteen Years

Teaching Resources: Chalk Board and Basic Science Text Book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. define the term Pollution

ii. explain three (3) common types of environmental Pollution

Previous Knowledge: Students are aware of the discomfort of having smoke and garbage around their houses.

Introduction: The lesson will be introduced by revising the previous knowledge

Presentation: The lesson will be presented in the following steps:

Step One

i. The teacher will begin by explaining the concept of environmental pollution

ii. The explanation will proceed by classifying pollution into different types based on where they occur

Step Two

i. The lesson will proceed by trying to define each type of pollution

ii. Explain what agents of pollution are

Step Three

i. The teacher will then ask the students to briefly explain what air pollution, water pollution and land pollution are

ii. The teacher will then write the various definitions on the black board for the students to copy

Evaluation

The teacher will evaluate the lesson by asking the following questions:-

1. What is pollution?

Expected answer

The presence of unwanted elements in our environment is termed as pollution

2. Give three examples of places that can be polluted

Expected answer

The possible places where pollution can occur includes the following

i. The atmospheric air
ii. Water bodies
iii. land

Contamination of the atmospheric air with harmful gases or dust particles is termed as air pollution.

i. Water Pollution

Any physical, chemical, or biological change that affects the quality of water and renders the water as unfit for consumption is termed as water pollution.

i. Land pollution

Land pollution signifies the destruction or damage of the earth surface as a result of human activities.

Home work

The students will be asked to answer the same questions as take home assignment.

LESSON PLAN FOR CONTROL GROUP

WEEK THREE

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram.

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Air Pollution, causes, effects, and control measures.

Duration of the Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Chalk board and Basic Science text book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. define air pollution

ii. identify three (3) causes of air pollution

iii. explain two (2) effects of air pollution

iv. explain three ways by which air pollution can be controlled.

Previous Knowledge: Students have learnt about the concept of pollution and types of pollution.

Introduction: The teacher will ask the following questions from the previous lesson on pollution:

i. What do you understand by the term pollution?

Expected answer:

Contamination of the environment is termed as pollution

1. Name three types of pollution

Expected answer:

i. Air pollution

ii. Water pollution

iii. Land pollution

Presentation

The lesson will be presented in steps in the following way:

Step One: The teacher will explain what air pollution means. Students will be asked to give typical examples of air pollution that occurs in our homes. The teacher will then write the definition of the pollution on the chalk board for the students to copy.

Step Two: The teacher will list out and explain some of the causes and effects of air pollution.

The students will be asked to enumerate the various illnesses that can be caused by air pollution.

The teacher will then briefly write the causes and effects of air pollution and ask the students to copy.

Step Three

i. The teacher will then explain some control measures of air pollution
ii. Students will be allowed to suggest possible ways that can be used as control measures of air pollution.

Evaluation: The teacher will evaluate the lesson in the following way:-

i. Summary the lesson
ii. Ask the following questions to ensure students understanding.

1. Define air pollution

Expected answer:

The contamination of the atmospheric air with harmful gases and dust particles is termed as air pollution

2. List out two causes and two effects of air pollution

Expected answer

The two causes of air pollution include the following:-

i. Emission of gases from industries into the atmosphere
ii. Emission of gases from auto mobiles

The two effects of air pollution are as follows:-

i. Air pollution affects the health of living organisms by causing illnesses like cholera, typhoid fever, and asthma.

Home work

The teacher will give the following questions as take home assignment

i. State and explain two control measures of air pollution

Expected answer

The two control measures of air pollution are as follows:-

i. The use of natural gas like liquefied petroleum gas
ii. The use of electrical stove rather than kerosene stove

LESSON PLAN FOR THE CONTROL GROUP

WEEK FOUR

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

Topic: Water pollution, causes, effects, and control measures.

Duration of the Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Chalk Board, and Basic Science Text Book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. Define water pollution.
ii. List three (3) causes of land pollution
iii. State two (2) effects of land pollution
iv. Explain three ways by which water pollution can be controlled.

Previous Knowledge: Students have learnt about air pollution

Introduction: The teacher will ask the following questions from the previous lesson on pollution:

i. What do you understand by the term air pollution?
ii. Explain three causes of air pollution

Presentation: The lesson will be presented in steps in the following way:

Step One

i. The teacher will first explain the concept of water pollution.
ii. Then write the definition of water pollution on the chalk board for the students to copy.

Step Two

i. The teacher will list out and explain some of the causes and effects of water pollution.
ii. The teacher will then briefly write out the causes and effects of water pollution and ask the students to copy.

Step Three

The teacher will then explain some control measures of water pollution.

Evaluation

The teacher will evaluate the lesson in the following way:

i. Ask the students to write down their findings.
ii. The teacher will ask the following questions:

1. Define water pollution

Expected answer:

Water pollution can be referred as a change in the biological, chemical, and physical properties of water that alters the quality of water and causes adverse effects to its users.

2. List out two causes and two effects of water pollution.

Expected answer:

The following are the two causes of water pollution

i. Discharge of industrial waste into water bodies.
ii. Dumping of refuse or dead bodies into water body.

Home work

The following questions will be giving to students as take home assignment

1. State and explain two control measures of water pollution

Expected answer:

The control measures of water pollution are as follows:

i. Rivers must not be used for dumping refuse
ii. Industrial waste must not be dumped in rivers

LESSON PLAN FOR THE CONTROL GROUP

WEEK FIVE

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

TOPIC: Land pollution, causes, effects, and control measures.

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Chalk board, and basic science text book.

Behavioural Objectives: \By the end of the lesson, the students should be able to:

i. Write out the definition of land pollution
ii. Identify three (3) causes of land pollution
iii. Explain two (2) effects of land pollution
iv. Explain three ways by which land pollution can be controlled.

Previous Knowledge: Students have learnt about water pollution

Introduction: The teacher will ask the following questions from the previous lesson on water pollution:

i. What do you understand by the term water pollution?
ii. Explain three (3) causes of water pollution.

Presentation: The lesson will be presented in steps in the following way:

Step One

i. The teacher will explain the meaning of land pollution.
ii. The teacher will then write the definition of land pollution on the blackboard students to copy.
iii. Students will be ask to list out various examples of land pollution.

Step Two

i. The teacher will list out and explain some of the causes and effects of land pollution.
ii. The teacher will then briefly write out the causes and effects of land pollution and ask the students to copy.

Step Three

i. The teacher will then explain some control measures of land pollution
ii. The students will be asked to suggest some possible ways of reducing the occurrence of land pollution.

Evaluation: The teacher will evaluate the lesson in the following way:

i. Ask the students to write down their findings.

ii. The teacher will ask the following questions:

1. Define land pollution

Expected answer:

The destruction and damage of the earth surface as a result of human activities is termed as land pollution.

2. List out two causes and two effects of land pollution

Expected answer:

The two causes of land pollution are as follows:

i. Mining, Erosion and Quarrying

ii. Forest fires and deforestation

The two effects of land pollution are as follows:

i. Polluted land is unfit for planting

ii. Land pollution destroys terrestrial habitat and kills the terrestrial inhabitants

Home work

The following question will be giving to the students as take home assignment

1. Write out two control measures of land pollution

Expected answer:

The control measures of land pollution include the following:

i. Planting of trees to prevent erosion

ii. The use of pesticide and fertilizers should be reduced

LESSON PLAN FOR CONTROL GROUP

WEEK SIX

Name of School: GGSS Gandun Albasa and GSS Ado Gwaram

Class: Junior Secondary School Two (JSS II)

Subject: Basic Science

TOPIC: General overview of Pollution

Duration of Lesson: 80 Minutes (double periods)

Average age of Students: Twelve to Fourteen Years

Teaching Resources: Computers, Personalized Computer Soft Ware Package, chalk board and basic science text book

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. Write out the definition of pollution in general
ii. Identify three (3) different types of pollution that occurs in our environment
iii. Identify one consequence of each type of pollution

Previous Knowledge: Students have learnt about air, water, and land pollution

Introduction: The teacher will instruct the students to carefully observe the various pictures showing environmental pollution from their computers

Presentation: The lesson will be presented in steps in the following way:

Step One: A preview of air, water, and land pollution pictures will be shown by the teacher using a power point presentation

Step Two:

i. The students will be ask to observe a scene of air pollution as a result of industrial activity from their computers.
ii. After clear observation the students should be ask to explain some of the possible consequences of air pollution

Step Three:

i. The students will be ask to observe a scene of water pollution as a result of industrial waste disposal into rivers.
ii. After clear observation the students should be ask to explain some of the possible consequences of water pollution

Step Four:

i. The teacher will instruct the students to further interface with their computers and find out some control measures of water pollution.

ii. The teacher will further instruct the students to move to the next stage where some of the control measures of water pollution are being enumerated.

Step Five:

i. The students will be ask to observe a scene of land pollution as a result of oil spillage from industries

ii. After clear observation the students should be ask to explain some of the possible consequences of land pollution

Step Six:

i. The teacher will instruct the students to further interface with their computers and find out some control measures of land pollution.

ii. The teacher will further instruct the students to move to the next stage where some of the control measures of land pollution are being enumerated.

Evaluation: The teacher will evaluate the lesson in the following way:-

i. Ask the students to write down their findings.

ii. The teacher will ask the students to show a picture of air pollution

iii. List out two causes and two effects of water pollution

Home work

The following question will be giving to the students as take home assignment

1. Write out two control measures of land pollution

Expected answer:

The control measures of land pollution include

The control measures of land pollution include the following:

i. Planting of trees to prevent erosion

ii. The use of pesticide and fertilizers should be reduced

2. Write out the control measures of water pollution

Expected answer:

i. By not dumping refuse in water bodies

ii. By not bathing or washing vehicles on river banks

iii. By avoiding the discharge of oils from industries into rivers

APPENDIX 8
RELIABILITY OUT PUT FOR BSAT

Scale: ALL VARIABLES

Case Processing Summary

	N	%
Valid	49	100.0
Cases Excluded[3]	0	.0
Total	49	100.0

a. List wise deletion based on all variables in the procedure.

Re liability Statistics

Cronbach's Alpha	No of Items
.945	2

Intra Class Correlation Coefficient

	Intra Class Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.896[a]	.822	.940	18.154	48	48	.000
Average Measures	.94 5[s]	.902	969	18.154	48	48	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

i. The estimator is the same, whether the interaction effect is present or not.
ii. Type C intra class correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.
iii. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise

APPENDIX 9
Reliability Output of PSAT

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded[3]	0	.0
	Total	50	100.0

a. List wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
763	2

Intra Class Correlation Coefficient

	Intra Class Correlation[3]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.61 *7*[3]	.410	.763	4.216	49	49	.000
Average Measures	.763[C]	.582	.865	4.216	49	49	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

i. The estimator is the same, whether the interaction effect is present or not.
ii. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.
iii. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

APPENDIX 10
PILOT STUDY RESULT OF PRETEST AND POSTTEST FOR BSPT AND PSAT

s/n.	Basic Science Performance Test		Process Skill Acquisition Test	
	Test	Retest	Test	Retest
1.	30	28	7	14
2.	30	28	9	18
3.	34	36	10	23
4.	22	20	9	19
5.	24	26	11	24
6.	24	26	8	13
7.	27	29	8	17
8.	23	25	7	14
9.	33	34	9	19
10.	26	28	9	19
11.	34	36	8	17
12.	26	28	7	13
13.	32	34	8	16
14.	34	28	9	20
15.	28	28	8	14
16.	34	36	10	22
17.	24	30	11	26
18.	28	28	7	14
19.	32	34	8	17
20.	26	28	7	14
21.	28	28	8	17
22.	26	28	9	17
23.	32	34	7	13
24.	25	28	8	17
25.	33	35	9	20
26.	30	32	8	17
27.	33	35	7	14
28.	29	28	8	16
29.	27	28	9	18
30.	21	26	7	13
31.	27	28	8	17
32.	21	26	9	19

33.	27	28	8	14
34.	27	29	12	28
35.	10	14	9	15
36.	27	30	11	23
37.	29	31	6	12
38.	18	22	7	13
39.	21	26	7	14
40.	21	25	8	17
41.	30	32	7	14
42.	33	35	7	14
43.	27	30	9	19
44.	28	28	7	14
45.	27	28	7	14
46.	27	28	7	14
47.	27	29	6	12
48.	27	29	8	17
49.	28	30	6	12
50.			10	19

APPENDIX 11
ITEM ANALYSIS FOR THE BASIC SCIENCE PERFORMANCE TEST (BSPT)

Item No	Lower (L)	Upper (U)	Item difficulty (U+L)N	Item discrimination index ((U- L/0.5N)
1	22	06	0.7	0.8
2	07	01	0.5	0.2
3	21	08	0.7	0.7
4	14	09	0.6	0.3
5	08	11	0.5	0.2
6	06	11	0.4	0.3
7	08	11	0.5	0.2
8	21	08	0.7	0.7
9	17	15	0.8	0.1
10	22	06	0.7	0.8
11	21	08	0.7	0.7
12	21	09	0.8	0.6
13	22	06	0.7	0.8
14	21	08	0.7	0.7
15	25	10	0.9	0.8
16	26	05	0.7	0.7
17	10	10	0.5	0.0
18	08	11	0.5	0.2
19	17	08	0.6	0.5
20	25	05	0.8	1.0
21	13	09	0.6	0.2
22	13	09	0.6	0.2
23	22	06	0.7	0.8
24	23	06	0.7	0.9
25	23	06	0.7	0.9
26	16	08	0.6	0.4
27	26	05	0.8	1.1
28	28	05	0.8	1.2
29	18	07	0.6	0.6
30	23	06	0.7	0.9
31	09	10	0.5	0.1
32	20	07	0.7	0.7
33	26	05	0.8	1.1
34	11	10	0.5	0.1
35	18	07	0.6	0.6
36	21	08	0.7	0.7
37	09	10	0.5	0.1
38	29	04	0.8	1.3
39	21	08	0.7	0.7
40	05	12	0.4	0.4

APPENDIX 12

ITEM ANALYSIS FOR THE PROCESS SKILLS ACQUISITION TEST (PSAT)

Item No	Lower (L)	Upper (U)	Item difficulty (U+L)/N	Item discrimination index (U-L/0.5N)
1	07	11	0.5	0.2
2	14	09	0.6	0.3
3	08	11	0.5	0.2
4	06	11	0.4	0.3
5	08	11	0.5	0.2
6	17	15	0.8	0.1
7	22	06	0.7	0.8
8	01	08	0.2	0.4
9	21	09	0.8	0.6
10	22	06	0.7	0.8
11	25	10	0.9	0.8
12	26	05	0.7	0.7
13	01	02	0.8	0.1
14	27	04	0.8	1.2
15	10	10	0.5	0.0
16	26	05	0.8	1.1
17	08	11	0.5	0.2
18	17	08	0.6	0.5
19	25	05	0.8	1.0
20	20	09	0.6	0.2

Table 3.4 showed that all the items are said to be within difficulty range between 0.0 and 0.8. The only item that did not fall within this range was item 11 where the difficulty index is 0.9. This is acceptable since it has helped to spread out the examinees' scores. The item discrimination index revealed that some of the items have very high discrimination index and were not consistent with Tristan (1995). However some of the items discrimination index was within the range 0.0 - 0.3 while most were above the range. This would mean that the items are not said to be too easy for the examinees. The instruments are therefore said to be valid for the study but with modifications for items 8, 14, 16, and 19. The index for the optimal difficulty level was estimated for a dichotomous response instrument

APPENDIX 13

EXPERIMENTAL GROUPS ONE&TWO AND CONTROL GROUPS ONE & TWO TAKING A PRE-TEST



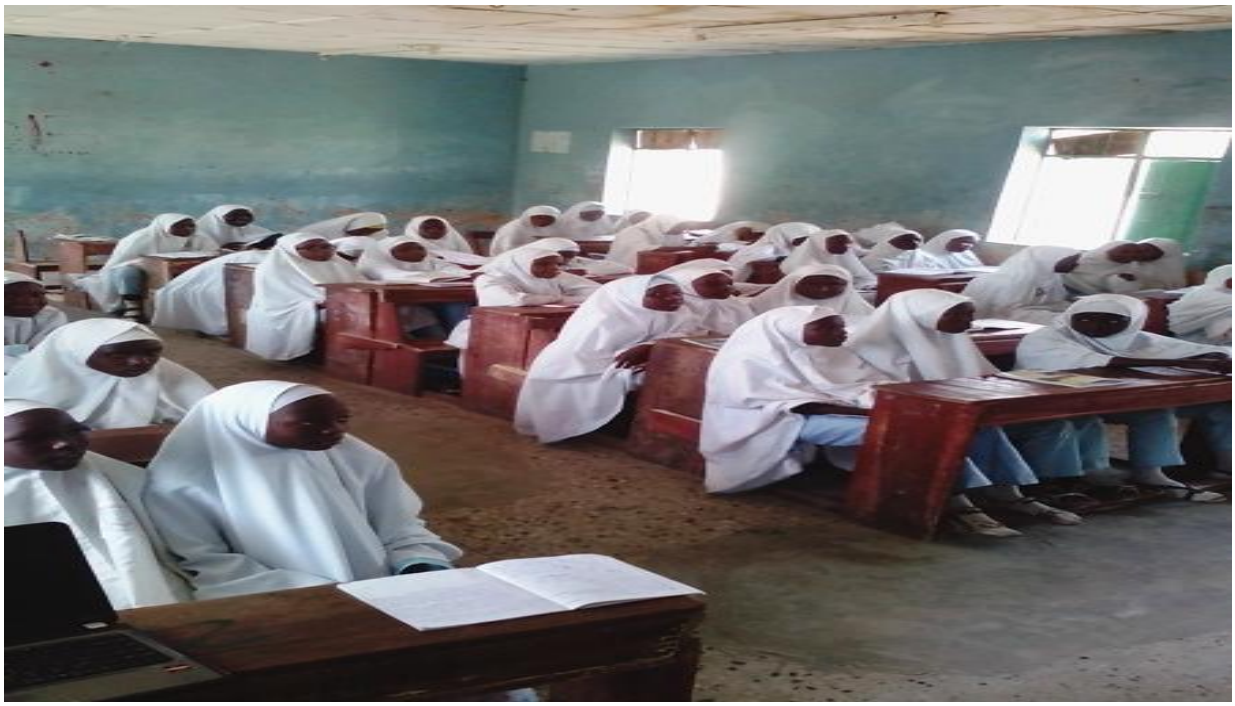
Experimental Group One



Experimental Group Two



Control Group One Taking a Pre-Test



Control Group Two Taking a Pre-Test

APPENDIX 13

EXPERIMENTAL GROUPS ONE AND TWO TAKING A LESSON USING CAI



Experimental Group One



Experimental Group Two

APPENDIX 14
COMPUTER-ASSISTED INSTRUCTION LESSON PREVIEW



OVERVIEW

- Definition of Pollution.
- Types of Pollution.
- Air Pollution.
- Water Pollution.
- Noise Pollution.
- Land Pollution.
- Radio Active Pollution.



DEFINITION OF POLLUTION

When Harmful Substances Contaminate the Environment, it is Called Pollution.

Pollution refers to the very bad condition of environment in terms of quantity and quality .



TYPES OF POLLUTION

There are Five types of Pollution:

- ❖Air Pollution
- ❖Water Pollution
- ❖Noise Pollution
- ❖Land Pollution
- ❖Radio Active Pollution



AIR POLLUTION

What is Atmosphere

- Atmosphere is the life blanket of Earth.
- It is therefore essential that we know more about the atmosphere and the ways in which it is Polluted.
- Air is considered safe when it contains no harmful dust and gases.



Causes of Air Pollution

Major sources of Air Pollution:

- ❖Industries.
- ❖ Automobiles and Domestic fuels.
- ❖ High Proportion of undesirable gases, such as sulphur dioxide and carbon monoxide.
- ❖Dust (e.g. cement dust, foundry dust and windblown solid dust)
- ❖Mist.
- ❖Smoke.
- ❖Carbon black.
- ❖Aerosols.



Effects of Air Pollution

Air Pollution affects???

- ❖Human health.
- ❖Animals.
- ❖Plants.
- ❖The atmosphere as a whole.
- ❖Global warming.
- ❖Ozone depletion(Ozone hole).
- ❖Acid Rain.
- ❖Various respiratory illnesses.







How to Avoid Air Pollution

Yes, we can avoid pollution As Follows:

❖Use natural Gases, like LPG (Liquefied Petroleum Gas) autos.



❖Do not Burst Crackers.

❖Use less Amount of Fuel for Vehicles.

❖Avoid using and use electric stoves (bio gas).



WATER POLLUTION

Any physical (temperature, oxygen), chemical (mercury), or biological (disease, sewage) change to water that adversely affects its use by alive beings.



Causes of Water Pollution



- About 40% of Deaths worldwide are caused by Water Pollution.
- Water Pollution is Caused by organic and inorganic industrial wastes and effluents discharged into rivers.
- Noise also causes anxiety stress reaction and fright.

Water Pollution Pictures



Effects of Water Pollution



- Diseases like Cholera.
- Malaria.
- Typhoid (spread during the rainy season).
- Aquatic life gets destroyed.



How to Avoid Water Pollution

- Rivers should not be used for washing clothes or bathing animals in.
- Harvesting of Rainwater to meet water requirements.
- Dams & embankments must be created.
- The rivers must not be contaminated.
- In rivers the dead bodies shouldn't thrown.



NOISE POLLUTION

✓Noise can be simply defined as unwanted sound.

✓The sound is pleasant or not depends upon its loudness, duration, rhythm and the mood of the person.

✓Noise pollution not only results in irritation and anger.

✓Noise Levels: Decibels (dB)

- Intensity
- Frequency
- Periods of exposure and
- Duration



Causes of Noise Pollution

✓Traffic Noise.

✓Aircraft Noise.

✓Noise from construction and civil engineering works.

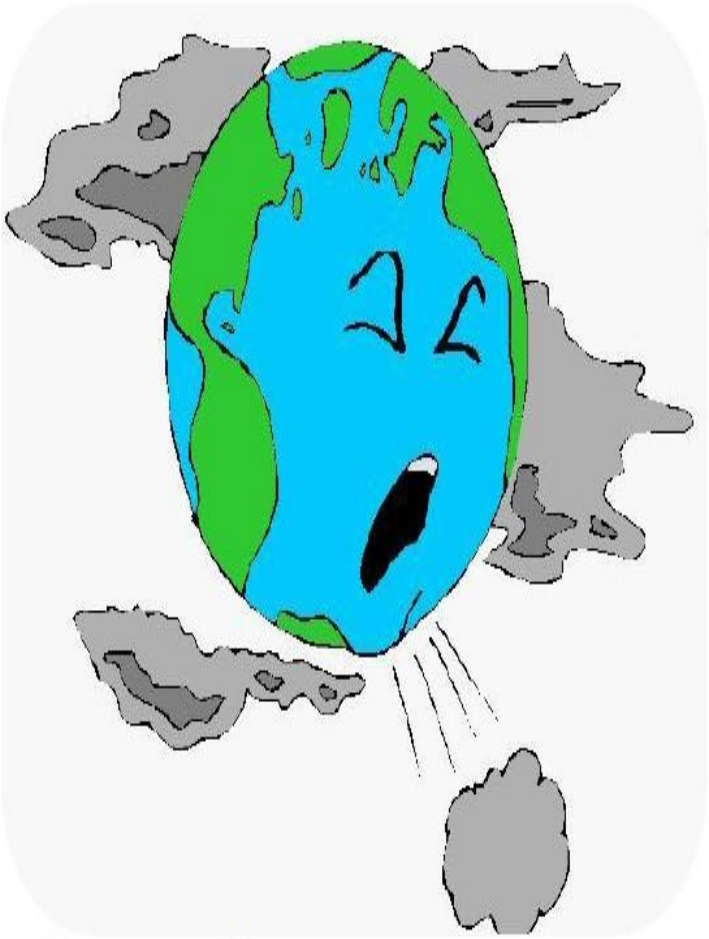
✓Noise from the Industries.

✓Noise from other sources.



See what is this?

Picture shows: Noise Pollution





Effects of Noise Pollution

✓Hearing Loss.

✓High Blood Pressure.

✓Stress.

✓Sleep Disturbance.

✓Colour Blindness.



How to Avoid Noise Pollution

- ✓ The Government should ensure the new machines that Should be noise proof.
- ✓ Airports must be away from residential area.
- ✓ The Sound horn symbol is to be in School Roads.
- ✓ Control noise at source by proper choice of equipment, design modification, mounting and proper layout.
- ✓ Isolation or use of baffles.
- ✓ Use of ear protection devices.



LAND POLLUTION

•One fourth of area is covered by land.

•Land is a earth which is occupied by people for shelter, occupation, etc...



Causes of Land Pollution

We can classify major sources in the following Categories:

- Mining, Erosion and quarrying.
- Household Garbage.
- Urbanization and Concentration of Population.
- Municipal Solid Waste.
- Industrial Waste and Hazardous Waste.
- Uncontrolled Land Treatment.
- Burning open dumps and forest fires.
- Deforestation.





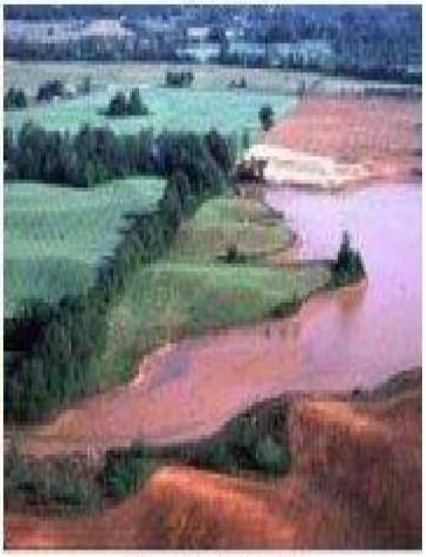
Plastic



Chemical



Truck



Fertilization

Effects of Land Pollution

- The Land Cannot use to build houses.
- Man cannot be farming.
- Ground water will gets Affected.
- Death of the animals that inhabit the land.



Prevention of Land Pollution

- More and more land should be brought under farming.
- Trees should be planted everywhere.
- Waste matter should be disposed immediately.
- Avoid drilling the Land for more underground water.
- Avoid using more fertilizers and Pesticides.
- Integrated Solid Waste Management.
- Good agricultural practices.
- Remediation of polluted soils.
- Prevention of erosion and silting.
- Containment of hazardous waste and waste water treatment using land treatment techniques.

3R Principle:

- ✓Reduce
- ✓Reuse
- ✓Recycle



RADIO ACTIVE POLLUTION

- Despite the Advantage of nuclear as a clean energy, the big concern is the resulted from nuclear reaction, which is a form of pollution called Radio activity.

- Radiation (Laser-Rays) will from Radioactive Pollution.



Causes of Radioactive Pollution

- Nuclear power plants(Ex: Neyveli, Kalpakkam).
- Nuclear Weapons(Ex: Missiles).
- Disposal of Nuclear Waste.
- Uranium Mining.



Effects of Radioactive Pollution

- The Diseases include blood in cough.
- Ulcer.
- Swelling of bone joints.
- Cancer.
- Lung Cancer.
- Skin Cancer.
- Bone Cancer.
- Eye Problems.



How to Prevent of Radioactive Pollution

- Avoid Constructing Nuclear Power Plants.
- Avoid Using Nuclear Weapon.
- Have Proper Treatment for Nuclear Waste.
- Avoid mining for Uranium to a minimal.



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