AVAILABILITY, ACCESS AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN TEACHING OF BIOLOGY IN PUBLIC SENIOR SECONDARY SCHOOLS IN KANO METROPOLIS

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES THROUGH DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION FACULTY OF EDUCATION, BAYERO UNIVERSITY KANO. IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE EDUCATION IN BIOLOGY

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DECLARATION

I declare that this dissertation entitled "Availability, Access and Use of Information and Communication Technologies (ICTs) in the Teaching of Biology in Public Senior Secondary Schools in Kano metropolis**"** has been conducted and compiled by me in the Department of Science and Technology Education under the supervision of Professor Muhammadu Abdullahi. The Information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at any university.

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CERTIFICATION

This dissertation entitled “Availability, Access and Use of Information and Communication Technologies (ICTs) in Teaching of Biology in Public Senior Secondary Schools in Kano metropolis” by Zubaida Hamza Muhammad meets the regulations governing the award of the degree of master of Science Education in Biology in Department of Science and Technology Education Bayero University Kano, and is approved for its contribution to knowledge and literary presentation.

_____ _____

Prof. Muhammadu Abdullahi Date

APPROVAL PAGE

This dissertation titled **"**Availability, Access, and Use of Information and Communication Technologies (ICTs) in the Teaching of Biology in Public Senior Secondary Schools in Kano state metropolis" by Zubaida Hamza Muhammad meets the requirements and regulations governing the award of the degree of Master of science education, in the department of Science and Technology Education Bayero University Kano and is approved for its contribution to knowledge and literary presentation.

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List of Abbreviations

AAUN : Atiku Abubakar University of Nigeria

ABTI: American University of Nigeria

ADEA: Association for the Development of Education in Africa

ALEF: Advancing Learning and Employability for a Better Future

ANOVA: Analysis Of Variance

ASE: Association for Science Education

CAD: Computer Aided Design

CAI: Computer Assisted Instruction

CBI: Computer Based Instruction

CD ROMS: Compact Disc Read-Only Memory

CMI: Computer Management Instruction

CNIPE: Center for National Educational Innovation and Experimentation

COE: College Of Education

COL: Common Wealth Learning

DNA: Deoxyribonucleic Acid

DVD: Digital Video Disc

EFA: Education for All

ETF: Education Trust Found

FCE: Federal College of Education

FME: Federal Ministry of Education

FRN: Federal Republic of Nigeria

FUC: Federal Unity College (Nigeria)

GPRS: Global Packet Radio Services

GSM: Global System of Mobile

ICT: Information and Communication Technology

ICTCJEQ: Information and Communication Technology Competence and Job Efficacy Questionnaire

ICTs: Information and Communication Technologies

ICTTC: Information and Communication Technology Technical College

INTEL: Integrated Telecommunications

IOB: Institute Of Biology

IOP: Institute Of Physics

IT: Information Technology

IWB: Interactive Whiteboard

KERD: Kano State Educational Resource Development

KSSSMB: Kano State Secondary Schools Management Board

LCD: Liquid Crystal Display

LCS: Library Computer System

LGAs: Local Government Areas

MDGs: Millennium Development Goals

MINEDU: Ministry of Education (New Zealand)

MIU: Mobile Internet Unit

MSTE: Ministry Of Science and Technology Education

NCEE: National Commission for Colleges of Education (Nigeria)

NEPAD: New Partnership for African Development

NGOs: Nongovernmental Organizations

NITAL: Nigerian Telecommunications Limited

NITDA: Nigerian National Information Technology Development Agency

NYSC: National Youth Service Corps

ODL: Open Distance Learning

PDAs: Personal Digital Assistants

RSC: Royal Society of Chemistry

SPSS: Statistical Package of Social Sciences

STSB: Science and Technical Schools Board

TICTUSQ: Teachers' Information and Communication Technology Usage Survey Questionnaire

TV: Television

UIS: UNESCO Institute for Statistics

UK: United Kingdom

UNESCO: United Nations Educational Scientific and Cultural Organization

US: United State

USAID: United States Agency for International Development

VHF: Very High Frequency

VSAT: Very Small Aperture Terminal

WSIS: Word Summit on Information Society

WWW: World Wide Website

ABSTRACT

This study was aimed at determining the Availability, Access and Use of Information and Communication Technologies (ICTs) in Teaching of Biology in Public Senior Secondary Schools in Kano metropolis. Five research questions and one hypothesis was drawn to guide the study. Related literatures were reviewed after the conceptual framework based on the major variables of the study. A Survey research design was adopted to conduct the study. The population of the study comprised of all the Biology Teachers in Public Senior Secondary Schools in Kano Metropolis. They were two hundred and eighteen (218) in number. Sample sizes of fifty eight (58) Biology teachers were used for this study using cluster and simple random sampling techniques. The questionnaire used for the study was titled ICTs and Senior Secondary Schools Biology Teachers' Questionnaire (ICTSSSBTQ). The questioonaire was adapted from a questionnaire tagged ICT and Federal Colleges of Education Lecturers Questionnaire (ICTFCELQ). Test re-test method was used for pilot study and Pearson product moment correlation coefficient was used to determine internal consistency of the questionnaire and reliability coefficient of 0.89 was obtained. Descriptive and inferential statistics were used to answer research question 1-5 and also to test the research hypothesis using 20 version of Statistical Package for Social Science (SPSS). The findings of this study revealed that ICT facilities are not Available and not Accessible for Teaching of Biology in Public Senior Secondary Schools in Kano metropolis. It was also revealed that Public Senior Secondary Schools Biology Teachers are not Utilizing basic ICT facilities during the course of Biology instruction. This study found out that a significant difference exists between male Biology teachers and female Biology teachers on the level of ICTs competence for effective teaching of Biology. It is recommended that there is a need for Kano state policy makers to respond positively towards provision of adequate ICT infrastructures and functional internet facilities in all the public Senior Secondary Schools across the state. This is to encourage and motivate teachers to utilize them during teaching and learning.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Biology is the study of living things from familiar complex multicellular organism that live in many different habitats of biosphere to single celled microorganisms that live in seemingly inhospitable conditions. It is the study of the dynamic relationship between living things, their inter dependence, their interaction with non-living environment and the process that maintains life and ensures its continuity (Victorian, 2012). The understanding of living things only started to grow rapidly with the advent of techniques and Technologies developed in the 18^{th} and 19^{th} centuries, not least the invention of microscope and the realization that natural selection is the process that has driven the evolution of life. Biologist attempts to understand the living world at all level using many different approaches and techniques. At one end of the scale is the cell (the basic structural and functional unit of life), its molecular construction and complex metabolic reactions. At the other end of the scale Biologist investigate the interactions that make the whole ecosystems of the earth function (International Baccalaureate Organization, 2014).

Knowledge gained through Biology played an important role in the society. It has been use to solve problems of disease and poor yield in agriculture by production of disease resistant and high yielding plants and animals reduce over population through the development of hormone contraceptives, and also protection and management of the environment (Maundu, Sambili, and Muthwii2005; Campbell & Reece, 2002).

Biology enables individual to understand that, despite the diverse ways of meeting the challenges of survival, all living things have many structural and functional characteristics in common. Modern Biology draws on increasingly specialized fields of bioscience such as biochemistry, neuroscience and cell and molecular Biology including studies of genomics and proteomics. It makes connections between these fields and the disciplines of physics, chemistry, earth science and space sciences in exploring the nature of past and present life and the possibility of life forms beyond our planet. Students acquired knowledge and skills of inquiry that help them to examine critically issues that arise in their own lives and that of the public, to take part in making decision about their own health and wellbeing and that of society. They build an understanding of the interconnectedness of all living things and their environment. The values and attributes that students develop will help them to recognize the strengths and limitations of science, respect evidence and the sensitive to differences in views and beliefs held by others. They will be able to work collaboratively and yet state their own views from an informed position. The study of Biology prepares students for continuing studies in bioscience and entry into the workforce in a wide range of careers, including those that not thought as depending on bioscience. Much of our economic activity is generated through advances in bioscience research, in environmental, medical and associated biotechnologies. Students develop knowledge of bioscience and skills of science inquiry and the values and attributes that will help them to consider issues and implications associated with the application of biological techniques and technology (Victorian, 2012).

Biology curriculum is designed to provide students with the knowledge of the concepts in Biology, to promote their knowledge of the world around them, as well as developed broadly applicable skills such as problem solving, Communication, critical thinking, and objective

reasoning ability to prepare the students for workplace and self-sustainability in the world economy (FME, 2008).

ICTs have become an important device with revolutionary influence on how people live in the world. The place of ICTs in education and the world in general cannot be left unconsidered. Modern day businesses, transactions, are organize and carried out through the use of telephones, fax machines, and computer Communication network via the internet. The phenomenon has given birth to the modern occurrence of e-commerce, e-government, e-medicine, e-banking and e-education among others. The educational sector has certainly been affected by the penetrating effect of ICTs worldwide and in particular developed countries (Hilty, 2008). ICTs have made a great and striking effect toward producing quantitative and qualitative Teaching, learning and research in educational setting (Yusuf 2005). Watson (2001) observed that ICTs have revolutionized the way people work today and are now changing educational system improvingly. As a result if school train children in yesterday's skills and technology that may not be effective and fit into tomorrow's world. This is the rationale for ICTs to win global recognition and attention. For instance, ICTs are important technological devices that help towards facilitating attainment of one of the Millennium Development Goals (MDGs), which is the achievement of universal primary education by the year 2015. Aina (2004) pointed out that in order to attain the goal of universal primary education by the year 2015; it is must to ensure that ICTs unlock the door of educational system. This signifies that the growing demand and increasingly important place ICTs could receive in education. Since ICTs provide greater chance for learners and instructors to adjust learning and teaching to individual needs. Society is forcing Schools to give an appropriate response to this technical innovation.

ICTs influences not only what learners should learn, but also plays a significant role on how the student should learn. Moving along with a shift of curricula from" content-centered" to "competence based". The mode of curricula delivery has now shifted from "teacher-centered" form of delivery to "student-centered "form of delivery. ICTs provide learning curiosity. ICTs such as video, television and multimedia computer software that combine text, sound and colorful moving image can be used to provide challenging and authentic content that would enable Biology student fully participate during the process of learning. Interactive radio that make use of sound effects, songs, dramatization, comic skits and other ways student perform force students to listen and become more engage during Teaching and learning period.

ICTs have the potential towards producing new method of Teaching that would help provide qualitative learning which would motivate and enable Biology students collaborate and help them relate experiences gained in school to outside school environment (Davis &Tearle, 1999, Lemke &Coughlin 1998; cited by Yusuf (2005). Jhurree (2005) pointed out that, initially, computers were used to teach computer programming, but with the advent of microprocessors in the early 1970s brought the introduction of affordable microcomputers into school at a rapid rate. Computers and application of Technologies became more pervasive in society which led to a concern about the need for computing skills in everyday life. Hepp, Hinostroza, Laval, &Rehbein (2004) claim in their paper "technology in Schools education, ICTs and the knowledge society" that ICTs have been utilizes in education ever since their inception, but they have not been always massively present. Although, at that time computers have not been fully integrated and provided in the learning of traditional subject matter. The commonly accepted rhetoric that education systems would need to prepare citizens for lifelong learning in an Information society boosted interest in ICTs (Pelgrum& Law, 2003). As new concepts of

learning have evolved, teachers are expected to facilitate learning and make it meaningful to individual learners rather than just to provide abstract knowledge and skills (Adelabu &Adu, 2014). Great deals of research and development have been conducted in order to bring Information Communication Technology (ICT) to its current state of art (Olusesan& Emmanuel, 2015). ICT was originally intended to serve as a means of improving efficiency in the educational process (Eze, Adu &Rrramani, 2013).

Furthermore, it has been shown that the use of ICTs in education can help improve memory retention, increase motivation and generally deepen understanding (Underwood &Dillon, 2011). ICT can also be used to promote collaborative learning, including role playing, group problem solving activities and articulated projects. Generally, ICTs is promoting new approaches to working and learning, and new ways of interacting. Consequently, the introduction of ICTs into Schools has provoked a host of new questions about the evolving nature of pedagogy (Adu et al., 2014).

It is realized that among the many problems facing the quality of education, is the inadequate facilities and equipment with which the teachers can use to teach. Probably that is why David (2010) believed that introducing technology into Schools is largely dependent upon the availability and accessibility of ICTs resources (e.g. hardware, software and Communications infrastructure). Clearly if technology cannot be accessed by the teacher, as in so many educational settings in Schools, then it will not be used. We know that state funding for such resources is scarce, and that ICT resources tend to be more available only at the tertiary level of education in Nigeria.

The adoption and use of ICTs in education specifically in Teaching Biology have a positive effect to influence Teaching; learning and research as it affect the mode of content

delivery and provide opportunity to widely access to the content. It increases flexibility so that learners can be opportune to approach the knowledge regardless with time and geographical barriers. ICTs integration in Teaching and learning makes it possible for teachers to upgrade their knowledge and skills on Information Communication Technology in the Biology instruction (Emily, 2014).There is need for Secondary school education to produce citizens who are to be scientifically and technologically literate with high ICTs competence to enhance nation development. Successful and effective Teaching of Biology could be aided where there is availability of Information and Communication Technologies (ICTs) and teachers could be able to access and utilize them during the course of instruction. Levy and Murmane (2004) pointed out that ability to work with ICTs is seen as one of the important competent keys necessary for success in life and competition in the labor market. A study conducted by Yusuf, Maina and Dare (2013) on assessment of availability, utilization and management of ICT facilities in Teaching English language in secondary schools in Kaduna state, nigeria.the findings of the study revealed that some of the ICT facilities are available in most of the schools but teachers are not utilizing them during instruction because the teachers are not competent to use such ICT facilities. Aina (2012) pointed out that method of teaching has gone beyond traditional method of chalk and talk method. According to Shed (2004) any one preparing to become teacher most take in the use of technology in their Teaching environment.

To become great among the committee of nations, Nigeria must change the strategy employed for Teaching and learning of science education from traditional way of talk and chalk method and reading by carrying books around to integrating ICT resources to all educational setting. The world is in the era of ICTs where Information is not restricted by time, space and channel. Teaching and learning could be done everywhere in the bedroom, on the sea and even in

the air, it is not restricted in the classroom any more (Awolaju, Akinloye, and Ilori, 2010).There is a need of modern way of Teaching and learning so that students' academic achievement in science particularly Biology can improve in all our educational setting. Science is not static, it is changing and new discoveries are coming up every day both in science and in method of Teaching; we can only benefit from these new development when we are connected to the world through ICTs. It is not an overstatement if one says scientific knowledge would not be taught adequately in any school of the world, without integrating the use of ICT, as argued by Olugbenga and Adebayo (2010) that ICTs have become a central focus in many developed and developing countries.

For all these reasons, the researcher intends to find out the availability, access and use of Information and Communication Technologies in the Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

1.2 Statement of the Problem

With the evolution of digital era of modern Technologies, the emphasis on the need for use of ICTs to promote meaningful learning and acquisition of Science Skills has created a global drive for acquisition and utilization of ICTs facilities in Schools. The suitability of ever educational system is often determined by the level of availability and access of these ICTs facilities for teachers and students to acquire competency in use of ICTs to acquire knowledge and skills. Yildrim (2007) pointed out that access to technological facilities is one of the effective ways to teachers' pedagogical use of ICTs in teaching and also effective adoption and integration of ICTs in teaching in secondary schools depends mainly on the availability and access of ICTs facilities. If teachers cannot access ICTs facilities during instruction, then they will not use them. Therefore, access to ICTs are key elements to successful adoption and integration of such

technologies during instruction.This calls for need of this study to determine availability, access and use of these ICTs facilities to enhance effective Teaching and learning of Biology.

Many teachers still depend much on the traditional pedagogical way of instruction instead of using current method of Teaching with ICTs Sanusi (2008).Teaching and learning have gone beyond the situation where by the teacher will stand and deliver the content in front of a group of pupils without involving students participation (Ajayi, 2008). Amuchie (2015) on his study titled Availability and Utilization of ICTs Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo Taraba State. The study found that ICTs resources are not available in Secondary Schools in Ardokola and Jalingo and the extent of utilization of ICTs resources in teaching and learning is equally very low. Another study conducted by Jegede (2013) on Students' Perception of the Availability and Utilization of Information Communication Technology (ICT) in the Teaching and Learning of Science Subjects in Secondary Schools in Ekiti State, Nigeria shows that ICT facilities are not available for science subjects instruction in Secondary Schools. Factors such as inadequate funding, cost of purchase, low internet connectivity, weak infrastructure, lack of skills, lack of basic infrastructure, dearth of technical support staff and teacher factor, are factors affecting the application of ICT in the Teaching and learning of science.

This study is designed to fill the gap to determine the level of Availability, Access and Used of ICTs in Teaching of Biology in Public Senior Secondary Schools in Kano metropolis.

1.3 Objective of the Study

The objective of this research study is to investigate the following

i. To find out the availability of ICTs facilities for the Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

ii. To determine the accessibility of the available ICTs by the teachers for the Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

iii. To determine the level of ICTs utilization by Biology teachers for the Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

iv. To find out whether Biology teachers have competence of utilizing different types of ICTs for Biological instructions.

v. To find out challenges Biology teachers are facing while accessing and utilizing ICTs in Biology classroom instruction.

1.4 Research Questions

This study seeks to find answer to the following questions.

i. Are public Senior Secondary Schools in Kano Metropolis provided with available Information and Communication Technology facilities for Teaching of Biology?

ii. Are ICTs materials easily accessible by teachers whenever they intend to use them for Biology class instruction?

iii. Do Biology teachers utilize ICTs resources during Biology class instruction?

iv. Do Biology teachers have competence of using ICTs materials for effective Teaching of Biology?

v. What are the challenges facing Biology teachers when accessing and utilizing ICTs materials for Biology class instruction?

1.5 Research Hypothesis

Hoi. There is no significance gender difference among Biology teachers in ICTs competence in Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

1.6 Significance of the study

The outcomes of this study would significantly be useful and of great benefit to:

Policy makers

Policy maker's woulds be provided with detailed Information of identifying the level of availability of ICTs for the Teaching of Biology. Software were already developed which shows action of viruses and bacteria which if teacher were to teach such topics verbally, students cannot be effectively taught and understood without seeing the microorganisms in action. Many plants in plant science, animals in zoology and insects in entomology can never be found here in Nigeria, but yet must be learnt by Biology student through the application of ICTs all these are made possible and available to students as if they are in real forms for the students to see them actively live. Computer assisted instruction (CAI)) tools such as word processor, spreadsheets and data bases are used to collect, organize, analyze and transmit Information. These tools also enable easy Communication among students, between students and instructors, even beyond the classroom experience to distant students and instructors.

School Authority

The finding would also be useful to school authority with Information on how to integrate ICT resources for efficient content delivery by Biology teachers in the classroom. This is by encouraging teachers to use ICTs to teach whenever they have access to any of the ICTs so that learners would fully participate in the teaching session, be motivated to learn and enhance meaningful learning and retention of the concepts learnt.

Biology Teachers

This research findings would give Secondary school Biology teachers insight into the efficacy of accessing and utilization of ICTs during Teaching and learning to use ICTs as a tool for designing new learning environment for their own subject-specific purposes to help their future students use the Technologies. It would also provide teachers with the knowledge, skills and attitudes to efficiently apply technology in their research, Communication, problem solving and continuing professional development through attending seminar and workshops.

Researchers

This research study would also be useful to other researchers that may wish to conduct their research on ICTs. This is by providing the researchers with Information of the level of ICTs availability, access and use by teachers, also competency level of ICTs among Biology teachers and challenges facing teachers towards access and use of ICTs in Teaching.

1.7 Scope of the Study

This study was delimited to Biology teachers of the public Senior Secondary Schools in metropolis area of Kano state, Nigeria. The study was on availability, access and use of

Information and Communication Technologies in the Teaching of Biology in public Senior Secondary Schools in Kano state metropolis. The study was also focus on ICTs competence by Biology teachers and challenges facing Biology teachers while using ICTs in Biology class instruction in public Senior Secondary Schools in Kano metropolis. The choice of the coverage area was due to the fact that, it is in Kano metropolis the huge number of Public Senior Secondary Schools are found. The types of ICTs concerned in this study are the basic ICTs facilities required for effective Biology content delivery and they include; desktop computer, laptop computer, Interactive white board, digital camera, projectors, television, DVD player and internet facilities. The study did not cover other ICTs facilities like; satellite, radio, Learning Management System (LMS), e-mail, podcast, vodcast, mobile phones etc.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

2.2 Conceptual Frame Work o ICTs

2.3 History to the Emergence of ICTs in Nigeria

2.4 ICTs in Education

2.5 Global Issues in ICTs

2.6 ICTs Issues in Nigeria

2.7 Availability, Access and Use of ICTs

2.8 Teachers' Competence in ICTs

2.9 Gender Variation in the Use of ICTs

2.10 Challenges Faced by Teachers towards Access and Use of ICTs

2.11 Review of Empirical Studies

2.12Uniqueness of the Study

2.13 Implication of the Study

2.2 Conceptual Framework

2.2.1 Concept of Information and Communication Technologies

ICTs are acronym meaning Information and Communication Technologies. Technically Information refers to data or facts that have been change into a meaningful and useful form to

the person receiving the message. It constitutes real facts which can help individual or organization produce assertively an effective and successful decision (Ugwuanya, 2012). Communication is the source and specified condition of conveying thoughts and imagination in such a way that could be learned and understood by the learner. It is the process of sending and receiving Information (Njoku, 2006).

According to the National Policy for Information Technology (2001) ICT is application of computer equipment, software and hardware and smaller procedure services including support services and related resources of any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, transmission or reception of data or Information.

Information Communication Technology (ICT) is a diverse set of technological tools and resources which are used to create, disseminate, store and manage Information (George, 2012). In the context of education Abolade and Yusuf (2005) described Information and Communication Technologies as essential tools in any educational system. ICTs include the use of computer, internet electronic mail (e-mail), satellite, telecommunication, global system of mobile (GSM) and Global Packet Radio Service (GPRS), world wide website (www) etc. ICTs also serve as a Teaching tool for computer use itself. These include word processing, analysis, database as well as graphics (audio and video) presentation and application (Mbakwem, 2006). According to Oduma (2014) ICTs are diverse set of technological devices and resources used for creating, storing, managing and communicating Information. For educational purposes, the ICTs can be used to support instruction as well as research activities, including collaborative learning and inquiry. One of the main applications of ICT in education is teaching and learning based on new Technologies. Apanpa and Lawal (2009) opined that the use of technology, and knowing

how technology can support student learning have become essential skills for professional teachers in today's world. ICT is a process of creation, processing, storage, retrieval and dissemination of Information and data using computer and telecommunication. The concept ICTs could be said to be Technologies for collecting, storing, processing, communicating and delivering Information (Ugwuanya, 2012). There is virtually no process in education that the ICT has not influenced. Basically, it has aided the processes in Teaching as well as the processes in learning, thus, giving rise to emerging areas of interest and study in the field of education (Fouts, 2010). As the processes keep changing with advanced in technology, the human resources involved in the processes of Teaching and learning are therefore, challenged to re-skill their abilities and competences in order to keep pace with the new trend and the penetration of ICT into education (Potashnik and Copper, 2009).

Information and Communication Technologies (ICTs) is advance in Technologies that provide a rich global resources and collaborative environment for dissemination of ICT literacy, materials, interactive and educative discussions, and research Information (Bates, 2011). ICT also enhances international exchange of ideas which are critical for advancing meaningful educational initiatives, training high skilled labour force, and understanding issues related to both education and economic development (Ololube, Ubogu and Ossai, 2011).Actually, ICTs in all its forms, old or modern, simple and complex, can be an effective tool that involves teachers and learners in reflection and development. These tools help learners to clear doubt and re- thinks their old belief, knowledge and understanding. ICT tools enable learners to compare new ideas with other individuals to evaluate whether new concepts and ideas are clearly reasonable and might be truthful. ICTs can remove an obstacle that hinders educators' ability to access Information (Oduma, 2014).

2.2.2 Components of ICTs

According to Ishaya &Muhammed (2014) ICTs are classified into olden and modern ICTs. The olden ICTs are the audio media, visual media, projected media; graphics etc. The audio media is applying to the auditory senses of hearing. They include radio sets, audio recording machine such as audio tapes, disc machines etc. The visual media appeals to the senses of seeing. They consist of pictures, photographs, diagrams, charts, cartoons, still pictures such as slides, filmstrips, transparencies etc. combination of audio and visual media gave new idea of audio-visual media that provide issues inform of pictures and audio effect commentaries of the picture, at the same time. They consist of television, video tape player, filmstrips/slides with inbuilt sound etc. Projected media was also then advanced where by content to be delivered are projected on the screen using a projector machine designed specifically to serve the purpose. It is usually the combination of software and the corresponding hardware. They consist of slide projector, overhead projector, video projector, 16mm projector, 8mm projector, 35mm projector, filmstrip projector, opaque projector etc. With technological advancement through the advent of computer, most of the projectors have become less utilized. This advancement brought about lots of innovation towards the advent of modern technology.

Pelgrum and Law (2003) states that near the end of 1980s, the term computer was replaced by IT (Information technology) indicating to have been shifted from computing technology to the capacity to store and retrieve Information. Then the introduction of Information Communication Technology followed around 1992 when e-mail started to become available to the general public.

Senthilkumar, Sivapragasammm & Sentamaraikannan (2014) Showed that various types of Technologies are to be found in Biology classrooms include:

- **Computer in the classroom:** Computer is a device makes teaching learning process easier. It is an essential tool for integrating ICTs in the classroom. Here, teachers are able to demonstrate a new lesson, illustrate and show new websites.
- **Class website:** It is a website that provides easiest way for teacher to display project work and assignment for students. Once the web page is designed, classroom works will be provided, homework assignments, famous quotations, games etc. Nowadays, children know how to use the computer and internet. So, most Schools provide teacher web pages that can easily be viewed through the school website.
- **Class blogs and Wikipedia:** Blogs are web-based journals or log book which are chronologically ordered web posting by an author and aWikipedia is a website to allow multiple members to edit a single document. Finally they create a truly collaborative and carefully edited file.
- **Wireless classroom microphones:** Are devices that accepts audio from up to three other sources and teachers have of the audio switching and volume from any where in the classroom Classrooms are very noisy in our daily occurrence with the help of microphones for students' clear understanding. Children learn better when they hear what the teacher is saying clearly.
- **Mobile devices:** they are devices that increasingly allow communication via photos, video as well as text messaging. Mobile devices like clickers or Smartphone can be used to enhance the learning experience of the students in the classroom. Where by teachers finally and easily get feed-back from them.
- **Interactive Whiteboards:** is a piece of hardware that looks much like a standard whiteboard that connects to a computer and a projector in the classroom to make a very

powerful tool. When connected, the interactive whiteboard becomes a giant, touch-sensitive version of the computer screen.An interactive whiteboard has given opportunity to touch control of computer applications. These enhance the Teaching-learning experience in the classroom through computer screen. This not only aids for visual learning, it is also interactive and the students can draw, write, or manipulate images on the interactive whiteboard.

- **Digital video:** it is a tool that concern with capturing, manipulation, and storage of moving images that can be displaced on computer screens.e.g LCD projector, DVD players help teacher in teaching learning process as proper as possible.
- **Online study tools:** They are Tools that motivate students learning by making studying more fun or individualized instruction for the student.
- **Digital Games:** They are games that helip learner to learn and memorize the content, collaborate, explore and obtain additional information to progress further in the game. Games like educational games have been growing significantly. The digital games are being provided as tools for the classroom and have given positive feedback, i.e. motivation for students. There are many other tools being utilized depending upon the school boards like state or central and also funds available in the institution. These may include: digital cameras, video cameras, interactive whiteboard tools, document cameras, or LCD projectors (Senthilkumar et al. 2014).

2.2.3 General Importance of Information and Communication Technologies

According to a United Nations report (1999) ICTs cover Internet service provision, telecommunications equipment and services, Information technology equipment and services, media and broadcasting, libraries and documentation centers, commercial Information providers,

network-based Information services, and other related Information and Communication activities. The field of education has been affected by ICTs, which no doubt affected Teaching, learning, and research (Yusuf, 2005). ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, to help them relate school experience to work practices, and also create economic viability for tomorrow's workers, as well as making Teaching stronger and helping Schools change (Dsavis and Tearle, 1999; Lemke and Coughlin, 1998; cited by Yusuf, 2005). As Jhurree (2005) stated that much has been said and reported about the impact of technology especially computers, in teaching and learning. Initially computers were used to teach computer programming but the development of the microprocessor in the early 1970s saw the introduction of affordable microcomputers into Schools at a rapid rate. Computers and applications of technology became more pervasive in society which led to a concern about the need for computing skills in everyday life.

(a) Enhancing Teaching and Learning

According to Zhao and Cziko (2001) three conditions are necessary for teachers to introduce ICTs into their classrooms: teachers should believe in the effectiveness of technology, teachers should believe that the use of technology will not cause any disturbances, and finally teachers should believe that they have control over technology. However, research studies show that most teachers do not make use of the potential of ICTs to contribute to the quality of learning environments, although they value this potential quite significantly (Smeets, 2005). For many years in a rapidly changing world, basic education is extremely important for an individual to be able to access and apply Information. Such ability must find include ICTs in the global village. Teachers have taught through lectures and presentations interspersed with tutorials and learning activities designed to consolidate and rehearse the content. Contemporary settings are

now favoring curricula that promote competency and performance. Curricula are starting to emphasize capabilities and to be concerned more with how the Information will be used than with what the Information is. Modern ICTs are able to provide strong support for all these requirements and there are now many outstanding examples of world class settings for competency and performance-based curricula that make sound use of the affordances of these Technologies (Oliver, 2000). The integration of Information and Communication Technologies can help revitalize teachers and students. This can help to improve and develop the quality of education by providing curricular support in difficult subject areas. To achieve these objectives, teachers need to be involved in collaborative projects and development of intervention change strategies, which would include teaching partnerships with ICTs as a tool. Harris (2002) conducted case studies in three primary and three Secondary Schools, which focused on innovative pedagogical practices involving ICTs. Harris (2002) concludes that the benefits of ICTs will be gained; when teachers are confidently and courageously willing to explore new opportunities of integrating and utilizing ICTs to change their traditional classroom method of Teaching. Since the use of ICTs will help to produce citizens who are to be scientifically and technologically literate for future lives and careers.

The influence of the technology on supporting how students learn will continue to increase if teachers are utilizing them during the course of instruction. In the past, the conventional process of Teaching has revolved around teachers planning and leading students through a series of instructional sequences to achieve a desired learning outcome. Typically these forms of Teaching have revolved around the planned transmission of a body of knowledge followed by some forms of interaction with the content as a means to consolidate the knowledge acquisition. Contemporary learning theory is based on the notion that learning is an active

process of constructing knowledge rather than acquiring knowledge and that instruction is the process by which this knowledge construction is supported rather than a process of knowledge transmission (Duffy & Cunningham, 1996). In this domain learning is viewed as the construction of meaning rather than as the memorization of facts (Lebow, 1993; Jonassen and Reeves, 1996). Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student centered settings and by enabling learning to be related to context and to practice (Berge, 1998; Barron, 1998). Teachers generate meaningful and engaging learning experiences for their students, strategically using ICTs to enhance learning. Students enjoy learning, and the independent enquiry which innovative and appropriate use of ICTs can foster. They begin to acquire the important of ICT skills which they will need in their future lives.

(b)Enhancing Accessibility of Education

ICTs increases the way delivery of education changes so that learners can access knowledge anytime and from anywhere. It can influence the way students are taught and how they learn as now the processes are more on learner centered and not by teachers. This in turn would better prepare the learners for lifelong learning as well as to improve the quality of learning. In harmony with geographical flexibility, technology-facilitated educational programs also remove many of the temporal obstacles that face learners with special needs (Moore &Kearsley, 1996). Students are starting to appreciate the capability to undertake education anywhere, anytime and anyplace.

One of the most vital contributions of ICTs in the field of education is easy access to learning. With the help of ICTs, students can now browse through e-books, sample examination papers, previous year papers etc. and can also have an easy access to resource persons, mentors,

experts, researchers, professionals, and peers-all over the world. This flexibility has heightened the availability of just-in-time learning and provided learning opportunities for many more learners who previously were constrained by other commitments (Young, 2002). ICTs also allow the academic institutions to reach disadvantaged groups and new international educational markets. As well as learning at any time, teachers are also finding the capabilities of Teaching at any time to be opportunistic and able to be used to advantage. ICTs also allow for the creation of digital resources like digital libraries where the students, teachers and professionals can access research material and course material from any place at any time (Bhattacharya and Sharma, 2007; Cholin, 2005). Such facilities allow the networking of academics and researchers and hence sharing of scholarly material (Cholin, 2005).

People have to access knowledge through ICTs to keep pace with the latest developments (Plomp, Pelgrum and Law, 2007). ICTs eliminate time barriers in education for learners as well as teacher. It eliminates geographical barriers as learners can log on from any place (Sanyal, 2001; Mooij, 2007; Cross and Adam, 2007; UNESCO, 2002; Bhattacharya and Sharma, 2007). Plomp, Pelgrum &Law (2007) state that the experience of many teachers, who are early innovators, is that the use of ICT is motivating for the students as well as for the teachers themselves. A great deal of research has proven the benefits to the quality of education (Al-Ansari 2006). Hepp, Hinostroza, Laval and Rehbein (2004), state that the literature contains many unsubstantiated claims about the revolutionary potential of ICTs to improve the quality of education. They also note that some claims are now deferred to a near future when hardware will be presumably more affordable and software will become, at last, an effective learning tools.

2.2.4 Benefit of Using ICTs in Teaching and Learning

Some of the benefit of using ICTs in teaching and learning has been found to assists students in accessing Information efficiently and effectively. As Brush, Glazewski and Hew (2008) stated that ICTs are used as a tool for students to discover learning topics, solve problems, and provide solutions to the problems in the learning process. ICTs provide access to acquisition of knowledge, and concepts in learning areas are understood while engaging students in the application of ICTs.

(a) Support Student-Centered and Self-Directed Learning

Student- Centered and Self- Directed learning has to do with a situation where teaching and learning are made to be carried out by the student him/her self with the role of the teacher as a facilitator. Students are now more frequently engaged in the meaningful use of computers (Castro Sánchez and Aleman 2011). They build new knowledge through accessing, selecting, organizing, and interpreting Information and data. Based on learning through ICTs, students are more capable of using Information and data from various sources, and critically assessing the quality of the learning materials.

(b) Produce a Creative Learning Environment

ICTs develop students' new understanding in their areas of learning (Chai, Koh and Tsai 2010).ICTs provide more creative solutions to different types of learning inquiries. For example, in a reading class, online books are commonly used in reading aloud activities. Learners can access all types of texts from beginning to advanced levels with ease through computers, laptops, personal digital assistants (PDAs), or iPads. More specifically, these e-books may come with some reading applications, which offer a reading-aloud interface, relevant vocabulary-building activities, games related to reading skills and vocabulary acquisition, and more. Therefore, ICTs

involves purpose designed applications that provide innovative ways to meet a variety of learning needs.

(c) Promote Collaborative Learning in a Distance-Learning Environment

Collaborative Learning in a Distance-Learning Environment concerned with the learning taking place among learners in a different geographical area through the use of ICTs. ICTs like; online group work allows students to become more active participants in the learning process. Contributing input requires that students comprehend what is being discussed, organize their thinking coherently, and express that thinking with carefully easy access to global resources, students can easily access online databases and subject experts in the online classroom. Koc (2005) mentioned that using ICTs enables students to communicate, share, and work collaboratively anywhere, any time. For instance, a teleconferencing classroom could invite students around the world to gather together simultaneously for a topic discussion. They may have the opportunity to analyze problems and explore ideas as well as to develop concepts. They may further evaluate ICTs learning solutions. Students not only acquire knowledge together, but also share diverse learning experiences from one another in order to express themselves and reflect on their learning.

(d) Offer More Opportunities to Develop Critical Thinking Skills

Based on a constructive learning approach, ICTs helps students focus on higher-level concepts rather than less meaningful tasks (Levin and Wadmany, 2006). McMahon's study (2009) showed that there were statistically significant correlations between studying with ICTs and the acquisition of critical thinking skills. A longer exposure in the ICT environment can foster students' higher critical thinking skills. Thus, Schools are strongly advised to integrate technology across all of the learning areas and among all learning levels. Where this is done,

students are able to apply technology to the attainment of higher levels of cognition within specific learning contexts.

(e) Improve Teaching and Learning Quality

Lowther, Inan, Strahl, & Ross (2008) have stated that there are three important characteristics which are needed to develop good quality Teaching and learning with ICTs: autonomy, capability, and creativity. Autonomy means that students take control of their learning through their use of ICTs. In this way, they become more capable of working by themselves and with others. Teachers can also authorize students to complete certain tasks individually or collaboratively. Through collaborative learning with ICTs, the students have more opportunity to build the new knowledge onto their previously background knowledge, and become more confident to take risks and learn from their mistakes. Furthermore, Serhan (2009) concluded that ICTs fosters autonomy by allowing educators to create their own material, thus providing more control over course content that is possible in a traditional classroom setting. With regard to capability, once students are more confident in learning processes, they can develop the capability to apply and transfer knowledge while using new technology with efficiency and effectiveness. For example, in an ESL listening and speaking class, students may be asked to practice their pronunciation using an online audio dictionary. They are required not only to listen to the native pronunciation from the dictionary, but also to learn the definitions and examples of a new vocabulary item. They then have to make a recording of their own pronunciation and provide examples of how this new word is used in context. Before completing this task, they have to know which browser to use in order to search a suitable online audio dictionary. They will have to browse several online dictionaries, and select the one that best meets their learning needs. In addition, finding good software to record their voice is another prerequisite for these

learners. Therefore, the whole learning process enriches students' learning skills and broadens their knowledge beyond what they already know. By using ICTs, students' creativity can be optimized. They may discover new multimedia tools and create materials in the styles readily available to them through games CDs, and television (Gee 2007, 2011).when a combination of students' autonomy, capability and creativity are combined, qualitative Teaching and learning through the application of ICTs can be improve.

(f) Support Teaching By Facilitating Access to Course Content

Reid (2002) has indicated, ICTs offers students more time to explore beyond the mechanics of course content allowing them to better understand concepts. The use of ICTs also changes the Teaching and learning relationship. Based on the findings of Reid's study, teachers reported that the relationship between teacher and learner is sometimes reversed with regards to Information technology. This relationship boosts students' confidence when they are able to help teachers with technical issues in the classroom environment. Therefore, ICTs changes the traditional teacher centered approach, and requires teachers to be more creative in customizing and adapting their own material. Watts-Taffe, Gwinn, & Horn (2003) found that teachers can act as catalysts for the integration of technology through ICTs. If the encouragement, equipment, and necessary technological support are available from institutes for the teachers, developing ICTs class will be easier for them. The main responsibilities of these teachers will be changing their course format, creating and explaining the new assignments, and arranging for the computer laboratory through their technology learning specialists or assistants.

2.2.5 Importance of Information and Communication Technologies in Science Education

There are many forms of ICTs tools, both hardware and software, that can support science teachers in creating new ways of Teaching which might increase the interaction between

students in the classroom. In this section, specific examples will be used to illustrate types of use of ICTs tools that blend into the science classroom and give students an enhanced uptake of ICTs in science, as well as better learning outcomes. Science teachers in Australia, for example, are provided with a range of ICT resources in the science classroom which include hardware such as digital cameras, data projectors, laptops, electronic overhead projectors, electronic whiteboards, and software such as interactive CDs, interactive applets, simulations, and electronic portfolios self-based online modules and websites for students and teachers (Dawson, Forster, & Reid 2006). These resources are used to prepare curriculum materials, manipulate data for analysis and report assessment results. Another example of the successful use of ICTs hardware tools was provided by Paine (2001), namely, that using specific ICTs tools in science education has given better results. For example, in the UK, over 4000 Intel digital microscopes were selected and distributed to high Schools for the Science Year. The aim of that project was to bring science alive in the classroom and focus on how ICTs can enhance Teaching and learning. At the same time, a research study was undertaken by Becta (2006) to show how teachers can use ICTs tools effectively with their subjects. Over 10000 lessons using ICTs in science were evaluated by the Association for Science Education (ASE). He added that Science Year was focused on improving the teacher's ability in using ICTs because there was a belief that ICTs was used very well and it would motivate the younger students, allowing more experimentation, analysis and presentation of results in a format allowing pupils to excel. Furthermore, it would encourage teachers to benefit from the science materials on the Web. Through the Science Year website (www.scienceyear.com) teachers and students can go through different lessons and use them and integrate them into their classroom focus attention instead on their intended learning objectives (Osborne & Hennessy 2003).

ICTs have become an essential factor in science education to enhance Teaching and learning. In addition, using video clips as a tool in education has allowed students who were ill or absent to catch up in their own time. Additionally, electricity and chemical modeling can be introduced using Web applications such as Java (a high level programming language in computer) to demonstrate things that students cannot physically see. The ICTs tools introduced to the school, particularly into the science classroom, have attracted teachers to become involved in different activities. With appropriate preplanning, teachers can make use of these tools. There is no doubt that through ICTs tools, teacher-student interaction have increased significantly in the classroom and the laboratory (Bell 2002).There is an expectation that science teachers particularly Biology teachers, will be able to effectively use a range of ICTs software related resources in the science classroom in order to enhance student learning (Senthikumar et al. 2014). No one can deny the benefit that science teachers can gain when they use ICTs software.

(a) Applications of ICTs in Science Education

There are many applications of ICTs in Teaching and learning of science depending on the knowledge of the user however, Collis and Moonen in Nguyen, Williams and Nguyen (2012) classification of these application in classroom Teaching includes the learning resources, instructional organization of learning and Communication. The classifications made use of educational software; computer- based testing system, e-mail system, internet, telephone, radio etc. Generally ICTs will be applicable in Computer Assisted Instruction (CAI), Computed Aided Design (CAD), Teleconferences and Library Computer System (LCS). CAI Interactions among students and teachers can be presented on computers in the form of text or in multimedia forms; this could include photograph, videos, animations, speech and music. This program could involve questions posed to students, returned feedback and additional questions could follow

based on the students' responses. CAD is used to design a plan or a product which could be architecture in nature or in automobile (Dawodu and Odusanya 2010). This is commonly used in industry for mass production of scientific and other equipment to reduce cost of production, reducing energy and time in production. Teleconferences Teachers and students can view take part in conferences and take part in a debate in the comfort of their offices or home through this medium. Through satellites, transmission of conference proceeding from far distance could be made available within few seconds without travelling at reduced expenses.Many libraries are computerized in such a way that students and teachers need not to stress themselves searching for books in the shelves again. Many books and journals are already archived in the library database and any Information on such books and journal could be retrieved in a matter of seconds.

(b) Benefits of ICTs in Science Education

Denby and Campbell (2005) in their study of ICTs in Support of Science Education: A Practical User's Guide, contributed to Earl's position by identifying that the use of ICTs in a science classroom had motivated both teachers and students, and the Teaching and learning was impacted positively. When teachers use ICTs tools correctly in their science subject, many interactive activities will appear for students to be involved with and their interest and attention span will increase. ICTs tools are playing important roles in enhancing Teaching and learning:

ICTs can provide access to a huge range of resources that are of high quality and connected to scientific learning. There are comprehensive websites which include a wealth of resources including ideas and Information: The Association for Science Education (ASE), The Institute of Biology (IOB), The Institute of Physics (IOP), and The Royal Society of Chemistry (RSC) (Denby& Campbell, 2005). Through this wealth of resources, teachers and students are able to

communicate with each other to increase their knowledge, sharing ideas and attuning online conferences with experts without needing to spend money on travel.

In other words, through those resources, the world comes into our hands. For instance, Nood (2007) (A science Teacher in Argo Community High school in South Side Chicago in the United States) has designed and created a website for both science teachers and students which includes lecture, video demonstration and interactive assessment. In fact, the website that has been created was a successful e-learning environment for science teachers (www.sciencewithmrnoon.com) to enhance their Teaching by simulating those lessons installed in this website. He also pointed out that there are free resources such as Model and The Collaborator Project that enable any tech-savvy school district to easily create e-learning environments comparable to Web and Blackboard. He also believed that the US Ministry of Education spent large amounts of money to equip a typical school with resources such as text books, work books, study guides, activities guide and other classroom items. He attempted to pilot programmed for science courses that could impact on the Teaching and learning of science subjects. He suggested that the government should supply ICTs materials to Schools free over the Internet, to encourage teachers to create their own websites. That could easily change teachers' techniques and save billions of dollars that are definitely needed for the supply of up–to-date Technologies in the classroom.

Bell and Gilbert (1994) emphasized that working with other teachers in the same subject area will increase knowledge and improve Teaching. Furthermore, they point out that teachers need to talk about what they are doing in the classroom and be encouraged to communicate with others, as well as adapting their Teaching roles. They added that teachers also needed to have feedback from students and progressive Information measuring their student's learning

outcomes. In some cases, the resources fill gaps where there are no good conventional alternatives; in other cases they complement existing resources. The multi-media resources available enable visualization and manipulation of complex models, three-dimensional images and movement to enhance understanding of scientific ideas; however, in some cases ICT resources are less effective than conventional alternatives and do not add to learning. Cowie, Jones, Harlow, McGee, Miller, Cooper & Gardiner (2008) noted that the general attitude of science teachers was positive about the benefits of greater access to a range of multimedia resources, including those on educational and other websites and CD ROMs and copies of electronic materials given to them by colleagues. Furthermore, for these teachers, the laptop had become a portable office that could be transported easily between school and home. Teachers had become familiar with their laptop, and most preferred to prepare their lessons at school sharing and acquiring knowledge with their colleagues.

2.2.6 Importance of Information and Communication Technologies in Biology

Biology deals with the study of living organism, their living environment and various interactions between living things and environment. The traditional content of Biology has been replaced by modern discoveries in the fields of cell Biology, basic genetics, bioengineering and biotechnology. Biology as a subject has both theory and practical components. ICTs have opened new avenues like, online learning, e-learning, virtual university, coaching, e-education, e-journal, etc. It has provided opportunity for the learner to use maximum senses to get the Information. . Learning of Biology can be made easier and more comfortable by integrating ICTs tools in instructional strategies for Teaching Biology. The students of Biology can make use of ICTs for easy understanding. ICTs can change traditional classroom into smart classroom and improve Teaching-learning process in Biology. The present century is marked by the explosion of

scientific knowledge, which has resulted in the present century is marked by the explosion of scientific knowledge, which has resulted in several educational innovations. Biological science deals with study of living organism, their living environment and various interactions between living things and environment. The relative popularity of Biology reflects a changing emphasis of curriculum. The traditional content has been replaced by modern discoveries in the fields of cell Biology, basic genetics, bio-engineering and biotechnology. This type of science related subjects are more important to their future studies. But, actual nature in our School system as well as college system gives more importance to 'Rote memory'. This type of study helped only for examination purpose and not for future of the students. Some of the institutions educate to the students by using education technology. 'Educational technology' is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources.The ICTs brings more rich material in the classrooms and libraries for the teachers and students. It has provided opportunity for the learner to use maximum senses to get the Information. It has broken the monotony and provided variety in the teaching – learning process (Agashe, 1995).

The computers were never developed for improving quality of Teaching – learning process. But researchers started using Computers for teaching purpose. It gave birth to Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), Computer Based Instruction (CBI), etc. People started developing CAI for teaching different subjects at School as well as Higher Education level (Hayes, 1998). Teachers also enhance their quality by using technology in Teaching. Science teachers need to know exactly how ICTs is used as a Teaching and learning tool, and to help students to use them for their own purposes. In particular, the major role of integrating ICTs in Biology instruction could be seen in the following:

Introductory Biology instruction often involves some reference to the atomic-molecular level of life. Many students in introductory courses have difficulty visualizing the three-dimensional shape of atoms and molecules, especially if the students' exposure is limited to two-dimensional stick drawings and figures. When students can visualize three-dimensional models of atoms and molecules moving freely in space, they gain a greater appreciation for how they make up biological structures (Francis, 2000).Nowadays, the interactive whiteboard (IWB) is regarded as a powerful media of instruction which not only supports clear and seamless instruction but also raises the level of interactivity in classrooms (Mercer, Hennessy, & Warwick, 2010; Mildenhall, Marshall, & Swan, 2010). Many researches indicate that students are more involved and motivated while Information and Communications technology (ICT) is present (Beauchamp &Kennewell, 2010; Chaudary& Sharma, 2012; Serow &Callingham, 2011).

The ICTs are new interface integrating all Teaching resources. It builds-in Teaching software and dynamic multimedia presentation that can attract students' attention and help them understand abstract concepts. In Biology Teaching, the visual/audio nature of ICT s presentations can improve student learning by delivering micro or dynamic representations of abstract concepts such as the process of cell division or the structures and functions inside body of organisms such as blood circulation, anatomy, physiology etc. ICTs support multimedia and multimodal presentation where multiple representations can be shown simultaneously on the screen to satisfy needs of students with different learning styles. Teachers can present many multimedia resources one the interactive white board (IWB) to improve Teaching efficiency. For example, the structures of chromosomes can be presented using images, videos or models to help students build chromosome models. In addition, students can use the IWB to improve and facilitate their learning process. Teachers can design Teaching activities for the IWB, which may

help students actively think and operate the IWB. For example, teachers can provide unfinished flow charts about the process of cell division for student to complete through discussion. Teachers can also provide students pictures about chromosomes' changes in each stage of cell division and make them arrange the pictures in right order and explain how the quantity of DNA (Deoxyribonucleic acid) and chromosome changes.

Umeh (2006) noted that the use of educational television and computer CD- Rom to teach aspects of Ecology and Genetics can be very effective for teaching and learning of Biology. Also, the use of TV and Video films can be very formidable especially for teaching biological concepts where practical field trips and demonstrations are difficult to embark on. The computer brought the usual Biology scheme alive, whereby students understood better. The Biology teacher, who was well informed about informatics, Use data handling software to analyze fieldwork data. Use simulation software to model changes in populations of bacteria in different conditions. Use sensors to record factors that affect photosynthesis. Search a database for Information about properties of materials. Use the Internet to find up-to-date Information about environmental issues. Use video or CD-ROM to study the solar system. Use spreadsheets to record, analyze and evaluate Information about diet.

Moreover, use of interactive whiteboard (IWB) supports rapid cross-page comparison and zoned page presentation. The differences between the two kinds of cell division can be clearly shown, enabling better understanding. The key characteristic of IWB, high interactivity, allows teachers to have more eye-contact and interaction with students, in addition to verbal Communication. It is also easier for teachers to design activities facilitating interaction and cooperation between students. Teachers and students feel closer to each other, as Wood(2002) argued, and students are more motivated to concentrate on and participate in Teaching activities

(Homles, 2009; Northcote, Mildenhall, Marshal and Swan , 2010; Slay &Hodgkinson 2008; Smith, Higgins, Wall & Miller, 2005). Building chromosome models is vital to the learning of cell division. The dynamic process of cell division and the micro-view of chromosome changes are also keys to overcome student learning difficulties in understanding cell division. If ICTs and multimedia and multimodal presentation can be effectively and properly used, student learning will be more effective when studying cell division.

The digital microscope engages students and shows them how truly fascinating common objects can be under magnification, promoting inquiry skills including observing, classifying, inferring, predicting and analyzing (Phil, 2008).Students can measure the diameter of blood cells on a microscope slide. Images are captured and results recorded. Soil particles, colour and soil organisms can also be observe using digital microscope. Most digital microscopes come with software that uses low magnification and this can be used in a range of experiments such as metamorphoses of a butterfly or moth, growth of slime mould, a flower opening, etc. Students observe the action on the computer and record their observations in a logbook (Phil, 2008)).

(a) Need for Integrating ICTs in Teaching and Learning of Biology

- To use ICT as a tool for designing new learning environments for their own subject-specific purposes to help future students to use ICTs.
- To provide the teacher with the knowledge, skills and attitudes to better use technology in their research, Communication, problem solving, and continuing professional development.
- To critically apply the pedagogical principles of ICTs integration in science education.
- To develop and facilitate ICTs-based learning activities in the context of Teaching Biology.

- To analyze and evaluate appropriate content and context for the use of ICTs in Biology Teaching.
- To use appropriate and varied Communication and multimedia tools (emails, websites etc.) in Teaching and learning Biology.
- To use ICTs efficiently in research, problem solving and project-based learning in Biology.
- To integrate ICTs appropriately into Biology curriculum activities that will foster students' ownership of their ICTs-rich learning environment (Senthekumar, Sivapragasam, &Senthamaraikannan2014).

2.3 Emergence of ICTs in Nigeria

Greene (2013) traced out the origin of ICT as a tool for work efficiency can be linked with the innovation of the abacus which is a counting device about 3000 B.C. The development of the abacus was used specifically for carrying out minimal calculations both in business and non-business ventures including education. The development of Information Communication Technology (ICT) in its modern form can however be traced back to the 16th century. According to Mohammed and Yarinchi (2013) the inception, growth, advance and impact of Information technology can be traced to the origin and impact of industrial revolution. It was during the era of industrial turnaround that effort was made towards inculcating the usage of technology in the production process. This achievement was gradually transferred to other countries around the world including Nigeria. In the process of time, other advanced devices were developed which could be used to deal with work related challenges encountered in all sectors of the economy. It

was from this achievement that various ICT facilities and equipment were developed to help solve modern day challenges in all spheres of life.

In Nigeria, Information technology is rather a recent phenomenon. Telecommunications, the oldest element, had a modest beginning with the first trunk telephone service in1923.It was not until the 1950sthat substantial expansion began with the introduction of VHF radio systems, 116 manual and five automatic telephone exchanges. In other to enhance the quality of telecommunications services in Nigeria, the telecommunications arm of the Post and Telegraph Department and the Nigerian External Telecommunications Limited, which previously managed the domestic and external services respectively, were merged in1984 to single profit-oriented limited liability company called NITEL. Under NITEL, the number of automatic switching centers in Nigeria grew to27 in July 1986. The national telex network grew also to a total capacity of 12,800 lines with only one international exchange having 1,500 trunks.

The use of Information Communication Technology (ICT) in Nigeria has a very recent history compared to other developed countries of the world. Ogunsola and Aboyade (2005) pointed out that the history of ICT in Nigeria can be linked to the development of trunk telephone services in the early 20th century. It was at this point that the adoption of Information Communication Technology facilities began to gain relevance in Nigeria. Based on this achievement, effort was made to expatiate on the use of ICT in the various sectors of the country. Ogunsola and Aboyade (2005) pointed out that in the 1950s, there was the introduction of the Very High Frequency (VHF) radio system and this contributed to the technological advancement of the country. From this period, effort has

been made by various technological experts to develop technological devices and facilities that will meet the needs of specific sectors of the economy including education.

2.4 Information and Communication Technologies in Education

ICTs are information handling tools that are capable of being used to generate process, store and retrieve, distribute and exchange information Amuchie (2015). Information and communications technology refers to a systematic process of gathering, processing, storing, sending and retrieving of information through the print, broadcast, computing and telecommunications media (Onwuagboke, 2014). Similarly, Achuonye (2002) sees information and communications technology as the collection, storage, processing, dissemination and use of information. ICTs are absolutely necessary especially in education and have been accepted as part of the contemporary world especially in the industrialized societies (Hannafin and Savenye, 1993).The merging of two Technologies brought about the concept of Information Communication Technology. The Communication technology supplies the means by which Information is being transmitted and the computer technology provided the structure for transmitting, receiving and processing of data. It also provided the means of storing and retrieving the Information. Thus, the Information Communication Technology is the integration of telecommunications (telephone lines and wireless signals), computers including necessary enterprise software, hardware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate Information (Stevenson, 1997).

The Communication technology comprises the radio, the television and the telephone technology, while the computer technology consists of the computer, satellite,

the wireless and the internet technology (Edward, 2007). ICTs therefore, include the 'old ICTs of radio, television and telephone, and the 'new' ICTs of computers, satellite and wireless technology and the internet (Potashnik& Copper, 2009). The combination of Information and Communication Technologies is what connected the whole world today into a global village. ICTs also enhances international exchange of ideas which are critical for improving meaningful educational initiatives, training high skilled labour force, and understanding issues related to both education and economic development (Ololube, Ubogu&Ossai, 2011). In fact, culture and societies are adjusted to meet the challenges of the ICTs knowledge world.

Ololube and others further noted that every nation invests heavily in education because it can produce unquantifiable benefits for individuals, organizations and the society as a whole. In this regard, the ICTs have been conveniently used to provide education both in the formal conventional face-to-face classroom interaction and in distant education offered with separation in terms of physical location of instructors and students (Potashnik& Copper, 2009). The combination of Information and Communication Technologies is what connected the whole world today into a global village. ICTs has not just networked the whole world, it has influenced virtually all human endeavors especially education. It could be said that ICTs is widely used in all aspects of education. Information and Communication Technologies (ICTs) is advance in Technologies that provide a rich global resources and collaborative environment for dissemination of ICTs literacy, materials, interactive and educative discussions, and research Information (Bates, 2011). In fact, culture and societies are adjusted to meet the challenges of the ICTs knowledge world.

2.5 Global Issues in ICTs

Information and Communication Technologies (ICTs) play a greater role across society including both public and private education sector. Countries around the world are more than ever in need of high quality internationally comparable statistics on ICT in all educational setting. In particular, indicators are essential for measuring and tracking the integration of ICT and its impact to a significant portion of national education budgets, for many, if not most of the countries (Jaco, 2015). In the United Kingdom (UK) alone, an estimated £567.8 million was spent on ICT in Schools, excluding software (Twining and Henry, 2014). This particular investment takes into account special attention given to teachers in providing them with the necessary policy environment, digital curriculum, skills, infrastructure, and professional development to make effective use of ICTs during the course of instruction in the classroom. Given the substantial size of investment in many countries, other literature sets targets for spending on teacher training suggesting that 30% of funding for ICT integration into Schools should be devoted to professional development to ensure that ICT is used effectively (Twining and Henry, 2014). This target is based on the firmly held belief that teacher training and ongoing relevant professional development are essential if benefits from investment in ICTs are to be maximized (Infodev, 2015).

Meeting international goals (e.g. Millennium Development Goals (MDGs], Education for All (EFA], World Summit on the Information Society (WSIS) by 2015 and beyond requires substantial investment in teacher training institutions so that adequate pre-service and in- service training can be delivered (UNESCO-UIS, 2006). According to Education for All Global Monitoring Report (2013/ 2014) states that an education system is only as good as its teachers. While the introduction of ICTs in education plays a role in shifting responsibility for learning

from teacher centered to student centered. ICT does not however remove the need for classroom leadership, nor does it invalidate related traditional teacher skills and practices (Infodev, 2015). While ICT has been used in various ways to support teachers, some of the literature points to the fact that little evidence exists supporting the claim that digital technology has transformed education (Twining and Henry, 2014). It is thus only by capturing better data on the integration, usage and impact of ICT in education that improvements to data collection processes can occur and best practices be scaled-up and rolled-out more effectively in countries (Jaco, 2015).

International ICT in education assessments recognize the importance of measuring teacher training and usage in regards to ICTs. However from a policymaking perspective, it is widely recognized that Information needs differ among countries depending on the level of ICT penetration in the education system. For example in countries where ICTs penetration levels are higher, there may be significantly more need for renewed training cyclically given the high turnover in digital technology. In contrast in countries where ICT penetration is less whereby fewer Schools have ICTs in place, training demands will also be significantly less (UNESCO-UIS, 2009). Data collection efforts should therefore aim to reflect relative needs.

In Asia and the Pacific it is suggested that countries such as Hong Kong Special Administrative Region of China, Malaysia and Singapore, where ICT is well integrated into curricula and nearly universally available across Schools, all teachers are trained to teach using ICT in their classroom. Moreover, other data suggest that all teachers in these three countries are using ICT in their Teaching. In contrast data suggest that few teachers are trained in countries where ICT is scarce including Philippines, Myanmar and Kyrgyzstan (UNESCO-UIS, 2014). Teacher training related to ICTs in education is thus also related to existing infrastructure, as also highlighted by Twining et al. (2015). In other words, one anticipates a directly proportional

relationship between ICT infrastructure and teacher training whereby as there is more and new infrastructure, training should increase. While training initiatives on ICTs are far from covering all teachers in Africa, studies reported that as far back as 2007 an estimated 61 different ICTs-related teacher training and professional development programmes, projects, and courses were under way in Africa (Farrell and Isaacs, 2007).

Understanding the complex evolving nature of ICT in general, additional clarity regarding the concepts "ICT-qualified" and "trained to teach subjects using ICT facilities" is needed. Consistent with this need for further reflection, Twining and Henry (2014) in an article entitled "Enhancing ICT Teaching in English Schools: Vital Lessons" argue that the term ICT has changed its focus over time and refers to several specific aspects of the use of technology within Schools, encompassing the specialist subjects, the use of technology to support learning across the curriculum, as well as digital technology itself.

Acknowledging the many dimensions to being "ICT-qualified" and "trained to use ICT to support teaching other subjects", the UNESCO ICT Competency Framework for teachers provides a helpful guide to codify ICT competencies and therefore can inform the development of new indicators to measure teacher training and preparedness. The UNESCO ICT Competency Framework for Teachers outlines the competencies that teachers need to integrate ICT into their professional practice. It emphasizes the role that ICT can play in supporting six major education focus areas across three growth phases of knowledge acquisition (UNESCO, 2011). Currently some international teacher training programmes are based on this framework, such as Partners in Learning from Microsoft or INTEL Teach to name only a few (UNESCO, 2011b).The UNESCO ICT Competency Framework for teachers could be seen in the table as follows;

UNESCO ICT competency framework for teachers

Area of educational focus	Module's phases of knowledge acquisition		
	Technology literacy	Knowledge deepening	Knowledge creation
Understanding ICT in education	Policy awareness	Policy understanding	Policy innovation
Curriculum and assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive
Organization and administration	Standard classroom	Collaborative groups	Learning organizations
Teacher professional learning	Digital literacy	Manage and guide	Teacher as model learner

On the issue of content of training, indicators indicate proportions of trained teachers; however they do not shed light on the content of teacher training and how it is delivered. In order to shed more light on what kind of ICT training is provided, UIS considered the inclusion of indicators that capture the content of teacher training. The ICT Education (2013) Survey on the use of ICT in Brazilian Schools, proposes the following elements to be captured under teacher training content: Steps towards ICT integration; Instructional practice; Content knowledge and curriculum support; Continuous lifelong learning; Introduction to the 21st century skills; Collaboration; Problem solving; Communication; Creativity and innovation; Self-regulation and initiative (Seo, 2013; Brazilian Internet Steering Committee, 2013).

Radio, television and the Internet are among the type of technology used in ICT enabled distance education to provide distance education opportunities, but some of these types are to be used in specific contexts. In particular, regional and or cultural differences have also been shown to be a factor in the use of ICT-enabled distance education in Africa. For example, a 2003 survey by the Association for the Development of Education in Africa (ADEA) Working Group

on Distance Education and Open Learning found that while the Internet and CD-ROMs were used in 35% of francophone institutions providing teacher training services, only 5% of anglophone and 0% of lusophone institutions, respectively, were also using them (Farrell and Isaacs, 2007). While many types of ICTs can be used to provide distance education opportunities and some are better suited to different contexts, the UIS survey does not capture this Information but rather groups all ICTs together.

Moreover, Training on assistive Technologies Enhancing pedagogy through ICT can also be a powerful means to improve equity in education and thus can be an important mechanism for inclusive education (UNESCO, 2014a). Once again the use of assistive Technologies can be highlighted, but teachers need to know how to use it in addressing the needs of people living with disabilities. Inclusive education and the use of assistive Technologies, however, are rarely covered in teacher training programmes so teachers typically do not have the skills to support children with a number of disabilities (UNESCO, 2014a) and this is especially so in developing countries. Nevertheless, some developing countries are establishing courses as part of teacher training. Grönlund et al. (2010), for example, provides an example from the United Republic of Tanzania whereby courses are on offer at the tertiary level to train Secondary education teachers on inclusive education. Meanwhile Bangladesh also offers courses on inclusive education but there is no regulation that requires teachers to take these courses, which are considered elective (Grönlund, Lim, and Larrson, 2010). The training of teachers to effectively use assistive Technologies also needs to be captured in new indicators.

In some developing countries, ICT training for teachers is based on developing computer literacy, which is an important component for integrating ICTs in education; however it is noteworthy that effective training should not stop at computer literacy but should model effective

Teaching practices (Infodev, 2015). Nevertheless, there are many other countries that provide little or negligible teacher training related to ICTs in education. For example evidence from Europe shows that 70% and 65% of students in Lithuania and Romania, respectively, are taught by teachers for whom it is compulsory to participate in ICT training, compared to just 13% or fewer of students in Luxembourg, Austria and Italy (European Commission, 2013).

UIS measures the proportion of teachers that are "ICT-qualified"; in other words it measures those teachers trained and thus best equipped to teach courses specifically on basic computer skills in primary or basic education and/ or computing in Secondary education. In contrast UIS indicator measures the proportion of primary and Secondary school teachers trained to teach other subject(s) using ICT facilities for ISCED levels 1-3. For both indicators, "trained" refers to national standards. In several countries across Latin America and the Caribbean (UNESCO-UIS, 2012), some Arab States (UNESCO-UIS, 2013), and some countries in Asia and the Pacific (UNESCO-UIS, 2014) varying proportions of teachers have received each type of training. Typically lower proportions of teachers have been trained to teach basic computer skills or computing (i.e. 10% or fewer), while the proportions of teachers trained to teach subjects using ICT varies more widely ranging from few in low income countries to the majority in some developed countries (Partnership on Measuring ICT for Development, 2014b). .

The current UIS questionnaire collects data on proportions of teachers that are trained to use ICTs in their Teaching. However, where teacher training on ICTs is compulsory, tracking proportions of trained teachers takes on an added dimension and helps countries track their own progress in meeting national standards. Moreover, countries may have different training requirements specific to various target audiences for instance according to educational level, by subject taught, etc. While the UIS survey currently includes questions on training disaggregated

by educational level, it might consider additional data that answers questions regarding whether or not ICT training is compulsory in the country and if so at which levels and subjects.

On the issue of ICT-enabled distance education, UIS indicator aims to capture data on the proportion of primary and Secondary teachers that are trained through ICT-enabled distance education programmes. Unfortunately little data currently exists; moreover the UIS indicator only covers current teachers and therefore does not measure the use of ICT-enabled distance education in pre-service training. It would be important to capture these different stages of professional development in the proposed indicators on teacher training of ICT in education. Additionally, the survey does not specify whether training is formal or informal in nature. Beyond collecting data on proportions of teachers trained through ICT-enabled distance education programmes, UIS should also elaborate an indicator that captures the extent of the training provided via ICT enabled distance education compared to on-site training. The ICT Education2013 Survey on the use of ICT in Brazilian Schools proposes the following elements to be captured under teacher training:

Proportion of teachers enrolled in continuous professional development of using ICTs including those attending ICT-enabled continuous professional development on site, those attending ICTs enabled continuous professional development via ICTs enabled distance education programmes, and those attending only via ICT-enabled distance education programmes (Brazilian Steering Committee, 2013). The type of technology used in ICTs enabled distance education include Radio, television and the Internet among others can be used to provide distance education opportunities, but some of these types are to be used in specific contexts. In particular, regional and or cultural differences have also been shown to be a factor in the use of ICTs enabled distance education in Africa. For example, a 2003 survey by the

Association for the Development of Education in Africa (ADEA) Working Group on Distance Education and Open Learning found that while the Internet and CDROMs were used in 35% of francophone institutions providing teacher training services, only 5% of anglophone and 0% of lusophone institutions, respectively, were also using them (Farrell and Isaacs, 2007). While many types of ICTs can be used to provide distance education opportunities and some are better suited to different contexts, the UIS survey does not capture this Information but rather groups all ICTs together.

Television has been shown to be effective delivery mechanism for ICTs in a number of developing countries. In the Arab States, the GENIE programme (2006) in Morocco trains teachers on using ICTs in education through distance education modes using television (MathémaTICE, 2009). Meanwhile, Interactive Television has also been used to further the integration of ICTs in education in Morocco by providing teacher training possibilities through interactive television (MathémaTICE, 2012).

The Internet, while not always available in all regions in developing countries, is another form of ICT that can deliver ICT enabled distance education. An Internet based Open and Distance Learning (ODL) programme for Teachers on ICTs can be found in Lesotho, where the Commonwealth of Learning (COL) and the Lesotho College of Education worked together to train academics on instructional design using ODL in 2002 (Daniel &Menon, 2007). In the Arab States, The National Centre for Educational Innovation and Experimentation (CNIPE), this is another Internet-based project as part of a partnership with the Advancing Learning and Employability for a better Future (ALEF). USAID funded project, provides teachers an online learning environment on how to create multimedia educational content. Meanwhile in Latin America both primary and secondary school teachers are trained via ICT-enabled distance

portals, grouped together under the Latin American Education Portals Network (RELPE). Countries in the region manage educational portals that offer local educational content to students and teachers (Gutterman, et al., 2009).

With regards to teacher resistance to ICT-enabled distance education, teachers frequently resist ICT-enabled distance education for several reasons. Where surveys have been carried out on ICT-enabled distance education, evidence exists that teachers frequently view online courses as of poor quality, for example teachers from the United Kingdom in preparation to the 'Vital courses' (Twining and Henry, 2014). Contrasting evidence however also exists that specific service providers such as the Open University are seen as delivering high quality distance education (Twining and Henry, 2014). In Africa, the number of primary and Secondary school teachers trained via ICT enabled distance education programmes other than radio and television seems to be hampered by a lack of ICT infrastructure and affordable connectivity; yet several initiatives do exist. For example UNESCO has launched an initiative in Kenya to train teachers on ICT integration in education, but the pilot phase of the project has not yet been evaluated (UNESCO, 2015a).

Uruguay provides another interesting example of how teachers can be less than universally accepting of ICT-enabled distance education, even though it may also be somewhat attributable to the lack of access to infrastructure, incentives, or convenience. For example, when trained on a voluntarily basis, Secondary school teachers showed a low participation rate (less than 10%), while primary teachers, which had ICT-enabled distance education imposed as the only means to take the course showed a significant increase with participation increasing up to 87% (UNESCO, 2011a). Given teachers' resistance to learning via ICT enabled distance education, data beyond administrative sources that target teachers can be instrumental to shed

light on teachers' deeper levels of engagement with ICT-enabled distance education. Moreover in Europe it is reported that a large majority of teachers choose to develop their ICT related skills during their own spare time which may include various means of professional development such as training provided by school staff and participation in online communities (European Commission, 2013).

2.6 ICTs Issues in Nigeria

Information and Communication Technologies (ICTs) are electronic Technologies used for Information storage and retrieval (Matthew, Joro, & Manasseh, 2015). Development is partly determined by the ability to establish a synergistic interaction between technological innovation and human values. The rapid rate at which ICTs have evolved since the mid-20th century, the convergence and pervasiveness of ICTs, give them a strong role in development and globalization. The field of education has been affected by ICTs, which have undoubtedly affected Teaching, learning, and research. ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening Teaching and helping Schools change (Davis and Tearle, 2010; Yusuf, 2011). In a rapidly changing world, computer education is essential for an individual to be able to access and apply Information. The Economic Commission for Africa has indicated that the ability to access and use Information is no longer a luxury, but a necessity for development. Unfortunately, many developing counties, especially in Africa, are still backward in ICT application and use (Aduwa,Ogiegbean and Iyamu, 2008).

2.6.1 The Need for ICT in Nigerian Education

ICT application and use will prove beneficial in improving Nigeria's educational system and gives student a better education. A technologically-advanced workforce will lead to ICT growth in Nigeria, with the potential to improve military technology and telecommunications, media Communications, and skilled ICT professionals who will be well-equipped to solve IT problems in Nigeria and other parts of the world. New instructional techniques that use ICTs provide a different modality of instruments. For the student, ICTs use allows for increased individualization of learning. In Schools where new Technologies are used, students have access to tools that adjust to their attention span and provide valuable and immediate feedback for literacy enhancement which is currently not fully implemented in the Nigerian school system (Matthew, Joro, & Manasseh, 2015).

The ability to use computers effectively has become an essential part of everyone's education. Skills such as bookkeeping, clerical and administrative work, stocktaking, and so forth, now constitute a set of computerized practices that form the core IT skills package such as; spreadsheets, word processors, and database (Reffell and Whitworth, 2010). The demand for computer/ICTs literacy is increasing in Nigeria, because employees realize that computers and other ICTs facilities can enhance efficiency. On the other hand, employees have also realized that computers can be a threat to their jobs, and the only way to enhance job security is to become computer literate. With the high demand for computer literacy, the Teaching and learning of these skills is a concern among professionals. This is also true of other ICT components. Improved education is essential to the creation of effective human capital in any country. The need for ICT in Nigerian Schools cannot be overemphasized. In this technology-driven age, everyone requires ICT competence to survive. Organizations are finding it very

necessary to train and re-train their employees to establish or increase their knowledge of computers and other ICT facilities. This calls for early acquisition of ICT skills by students (Matthew, Joro& Manasseh, 2015)

2.6.2 Issues in ICT Application in Nigerian Educational System

There are developments in the Nigerian education sector which indicate some level of ICT application in the Nigerian Schools. The Federal Government of Nigeria, in the National Policy on Education (Federal Republic of Nigeria, 2010), recognizes the prominent role of ICTs in the modern world, and has integrated ICTs into education in Nigeria. To actualize this goal, the document states that government will provide basic infrastructure and training at the primary school. At the basic school, computer education has been made a pre-vocational elective, and is a vocational infrastructure and training for the integration of ICTs in the school system. It should be noted that 2004 was not the first attempt the Nigerian government made to introduce computer education in Schools. In 1988, the Nigerian government enacted a policy on computer education. The plan was to establish pilot Schools and diffuse computer education innovation first to all Secondary and tertiary Schools, and then to primary Schools. Unfortunately, the project did not really take off beyond the distribution and installation of personal computers (Okebukola, 2007; cited by Aduwa-Ogiegbaen and Iyamu, 2008). Okebukola (2007), cited by Aduwa-Ogiegbaen and Iyamu (2008), concludes that the computer is not part of classroom technology in more than 90 percent of Nigerian public Schools. This implies that the chalkboard and textbook continue to dominate classroom activities in most Nigerian Schools.

The Federal Ministry of Education has launched an ICT driven project know as School Net (Federal Republic of Nigeria, 2010), which was intended to equip all Schools in Nigeria with computers and Communications Technologies. In June 2003, at the African Summit of the

World Economic Forum held in Durban, South Africa, the New Partnership for African Development (NEPAD) launched the e-schools elective at the Senior Secondary school. It is also the intention of government to provide necessary Initiative, intended to equip all African high Schools with ICT equipment including computers, radio and television sets, phones and fax machines, Communication equipment, scanners, digital cameras, and copiers, among other things. It is also meant to connect African students to the Internet. The NEPAD capacity-building initiative was executed for over a ten-year period, with the high school component being completed in the first five years. Three phases are envisaged, with fifteen to twenty countries in each phase. The phases are to be staggered, and an estimated 600,100 Schools are expected to benefit. The aim of the initiative is to impart ICT skills to young Africans Schools, and to harness ICT to improve, enrich, and expand education in African countries. The Nigerian Federal Government has commissioned a mobile Internet unit (MIU) operated by the Nigerian National Information Technology Development Agency (NITDA). The MIU is a locally- made bus that has been converted into a mobile training and cyber centre. Its interior has ten workstations, all networked and connected to the Internet. The MIU is also equipped with printers, photocopiers, and a number of multimedia facilities.

Although efforts have been made to ensure that ICTs are available and used in Nigerian Schools, the level of uptake is still low. NEPAD has scored the level of African continent students' experience with ICTs and their proficiency in using them very low. Fifty-five percent of students within the continent, including Nigeria, Algeria, Burkina Faso, Cameroon, Republic of Congo, Egypt, Gabon, Lesotho, Mali, Mauritius, Mozambique, Rwanda, Senegal, South Africa, and Uganda (who are participating in the first phase of the NEPAD e- Schools initiative), stated that they had no experience at all in using computers. Other findings included that the typical

African school environment provides neither opportunity nor training in using ICTS, and that 75 percent of responding teachers have no or very limited experience and expertise regarding ICT integration in education. Okwudishu (2005) discovered that the unavailability of some ICT components in Schools hampers teachers' use of ICTs. Lack of adequate search skills and access points in the Schools were reported as factors inhibiting the use of the Internet by school teachers.

The absence of ICT equipment in most Nigerian Schools leads students to resort to cybercafés for Internet access. Most cybercafé clients in Nigeria are students. The ICT revolution is yet to attain that critical mass required for it to register the necessary impact in the Teaching, student, and civilian population nationwide. While some Schools could be said to be in the vanguard, the majority of Nigeria's universities, polytechnics, nursing and midwifery Schools, and colleges of education lack computers. Many of the lecturers in these public institutions have to go to commercial cyber cafés before they can have access to a computer. The activities of NITDA, ETF, School Net Nigeria, and other stakeholders should gradually move the nation towards the realization of its ICTs vision as network operators and software developers take advantage of the opportunities offered to acquire essential expertise and technology in their areas of endeavor to help initiate generalized Internet usage. It is then that e-learning and ICTs application to education in general may come of age in Nigerian Schools.

2.6.3 ICT Policies in Nigeria

Nigeria started implementing its ICT policy in April 2001 after the Federal Executive Council approved it by establishing the National Information Technology Development Agency (NITDA), the implementing body. The policy empowers NITDA to enter into strategic alliances and joint ventures and to collaborate with the private sector to realize the specifics of the

country's vision of "making Nigeria to be IT capable country in Africa and a key player in the Information society by the year 2005 through using IT as an engine for sustainable development and global competitiveness." This vision is yet to be fulfilled. Outlined below are some of the objectives of Nigeria's ICT policy:

- To ensure that ICT resources are readily available to promote efficient national development
- To guarantee that the country benefits maximally, and contributes meaningfully, by providing the global solutions to the challenges of the Information Age.
- To empower Nigerians to participate in software and ICT development
- To encourage local production and manufacture of ICT components in a competitive manner
- To establish and develop ICT infrastructure and maximize its use nationwide
- To empower the youth with ICT skills and prepare them for global competitiveness
- To integrate ICT into the mainstream of education and training
- To create ICT awareness and ensure universal access in promoting ICT diffusion in all sectors of national life.
- To create an enabling environment and facilitate private sector (national and multinational) investment in the ICT sector.
- To encourage government and private sector joint venture collaboration
- To develop human capital with emphasis on creating and supporting a knowledge-base society.

- To build a mass pool of ICT literate manpower using the NYSC, NDE, and other platforms as a train-the-trainer scheme for capacity-building (Matthew, Joro & Manasseh, 2015).

2.6.4 Challenges Facing ICT Education in Nigerian Schools

ICT help to advance western and Asian countries, while African countries still experience a lag in its implementation, and this continue to widen the digital and knowledge divides. The following are challenges facing implementation of computer education in Nigeria:

1. Lack of Qualified Teachers to Teach ICT in Schools: The demand for ICT learning has been tremendous and the number of teachers who are trained to teach ICT cannot meet the demand. There are more students willing to be taught computing skills than there are teaches to transfer the skills.

2. Lack of Computers: Computers are still very expensive and despite spirited efforts by the government agencies, NGO, corporate organizations and individuals to donate computers to as many Schools as possible, there still remain a big percentage of the Schools unable to purchase computers for use by their pupils.

3. Lack of Electricity Supply: Many Schools are still not yet connected to electricity. Nigeria being a developing country, the government has not been able to connect all parts of the country to the national electricity grid. Consequently those Schools that fall under such areas are left handicapped and may not be able to offer computer studies.

4. Broken Down Computers: while a good number of Schools have benefited from donated used computers, they have not been adequately equipped with the same on maintenance and repair, hence its very common to see a Schools computer lab full of broken down computers, some

repairable and some not. This has actually been a major problem, and the government has now put strict measures on any person, NGO or corporate bodies willing to donate 2nd hand computers. (It is seen as a dumping ground); e-waste management.

5. Burglary: The fact that computers are still very expensive in Nigeria; this makes them a target for thieves who usually have ready markets to another party at a much less figure. This has made many Schools to incur extra expenses trying to burglar proof the computer rooms. This extra expense makes some Schools shy away from purchasing computers for their students.

6. Increased Moral Degradation Internet pornography, cyber bullying and other anti-social behaviors is a worrying emerging problem. The dilemma which arises in providing educational technology stems from a lack of financial resources and a limited distributive capacity. In addition, many African countries have not been able to employ teachers, and provide resources to keep up with this demand. This brings about compromised quality of education. Further, many African governments face the predicament of educational expansion that corresponds with economic development. Despite the setbacks, access to education is a strong focus of most governments (Matthew et al, 2015).

It could be seen that, the adoption and use of ICTs in Schools have positively influence its impact on teaching, learning, and research. Despite the roles ICTs can play in education, Schools in Nigeria have yet to extensively adopt them for teaching and learning. Efforts geared towards integration of ICTs into the school system have not had much impact. Problems such as poor policy and project implementation strategies and poor Information infrastructure militate against these efforts.

2.7 Availability, Access and Use of Information and Communication Technologies

ICT facilities have been identified to be very useful element in education particularly during instruction, dating as far back as the 1920s (Alter, Tiough &Nevkar, 2006) While access to relatively newer forms of ICTs (personal computers, mobile telephony, internet, etc.) While access to relatively newer forms of ICTs (personal computers, mobile telephony, internet, etc.) is important, access to the "older" Technologies such as transistor radios or analogue television cannot also be ignored. A study by Yildrim (2007) found that access to technological resources is one of the effective ways to teachers' pedagogical use of ICTs in Teaching. Effective adoption and integration of ICTs into Teaching in Secondary Schools depends mainly on the availability and accessibility of ICT resources such as hardware, software, etc. Obviously, if teachers cannot access ICT resources, then they will not use them. Therefore, access to computers, updated software and hardware are key elements to successful adoption and integration of technology.

Access to ICTs infrastructure and resources in Schools is a necessary condition to the integration of ICTs in education (Plomp, Anderson, Law, & Quale, 2009). Furthermore, in United State, the National Centre for Education Statistics (2000) as cited in (Afshari, Bakar, Luan, Samah, &Fooi 2009) report revealed that over 50% of the respondents used computers for research and lesson preparation in their Schools. About 78% of the respondents complained of inadequate access to computers in classroom. Of this percentage, 38% of the respondents stated that inadequate computers were not great barriers to ICTs use in their Teaching, but improved availability and fairness of access to technology resources by teachers, students and administrative staff is essential.

According to Ngwu (2014) on her study title Assessment of availability and utilization of ICT resources in Teaching in F.C.E Eha-Amufu Enugu Nigeria. Most ICT resources are not

adequately available in Schools. This therefore implies that, even though teachers are adequately trained and willing to inculcate the knowledge of the content they have to students, they are hindered from doing so by this unavailability of technological tools and laboratory resources. The same research revealed a low extent utilization of ICT facilities and related Technologies in the Schools under study. Yusuf, Maina and Dare (2013) conducted a study on Assessment of the Availability, Utilization and Management of ICT Facilities in Teaching English Language in Secondary Schools in Kaduna State, Nigeria. The findings of the study revealed that there is a dearth of ICT facilities in Secondary Schools in Kaduna as there are only very few of such facilities available in most of the Schools visited. It also revealed that most teachers were not competent in the use of these facilities as the management of these facilities requires training and re-training. Similarly, Adeji (2011) conducted a study on Availability and Use of ICT in South-Western Nigeria Colleges of Education. The findings of the study revealed non availability and low utilization of ICT equipment.

The findings of the study conducted by Tah (2012) on Availability and utilization of ICTs tools for effective instructional delivery in tertiary institutions in Cross River State, Nigeria have clearly revealed that the availability and utilization of ICTs tools for effective instructional delivery in tertiary institutions in Cross River State is low. Jude and Dankaro (2012) conducted a study on ICT Resource Utilization, Availability and Accessibility by Teacher Educators for Instructional Development in College of Education katsina- Ala. The study revealed that ICT resources were not available and because of that reason, teacher educators could not access and utilize them for instructional development purposes. Pelgrum (2001), in Idoko and Ademu 2010; Eriba and Adejoh (2004), in Idoko and Ademu (2010), both found out that ICTs availability often been one of the most important obstacles to technology adoption and integration in

instruction. Idoko and Ademu (2010) in an investigation of the challenges of ICTs for teaching/learning as perceived by agricultural science teachers in 210 Secondary Schools from the three educational zones in Kogi State also found those ICT facilities were not available in Secondary Schools. Similarly, Fakeye (2010) also investigated English language teachers' knowledge and use of ICTs in Ibadan Southwest LGA of Oyo State and found that availability of computers and their connectivity to the internet was non-existent in virtually all the school studied and utilization, which is dependent on availability, and because availability is poor, the usability was also found to be poor. Another study conducted by Mavellas, Wellington &samuel (2016) on Assessment Of The Availability And Utilization Of ICT For Teaching And Learning In Secondary Schools In Kwekwe, Zimbabwe. The finding shows that ICT resources are inadequate and the extent of utilization is low.

Similarly, Eze and Aja (2014) conducted a study on Availability and utilization of Information Communication Technology (ICT) in Ebonyi Local Government area of Ebonyi state. The study found that the availability of ICTs devices is not adequate and the available ICT devices are not effectively utilized. Meanwhile, availability, accessibility and utilization of ICT resources will be of great help towards improving the quality of Teaching and learning particularly Biology. This research study intends to findout wether there are Availability, Access and Use of ICTs in Teaching of Biology in Public Senior Secondary Schools in Kano metropolis.

2.8 Teachers Competence in ICTs

Computer competence is defined as being able to handle a wide range of varying computer applications for various purposes (Van Braak, Tondeur, &Valcke, 2004). The success of integrating Information and Communication Technologies into the educational system depends largely on the skills and knowledge of instructors (Agbumu and Ademu, 2010). Khalid

(2009) explains that confidence, competence and accessibility have been found to be the most critical components towards technology integration in Schools. According to Bordbar (2010), teachers' computer competence is a major predictor of integrating ICT in Teaching. Evidence suggests that majority of teachers who reported negative or neutral attitude towards the integration of ICTs into Teaching and learning processes lacked knowledge and skills that would allow them to make "informed decision". In a qualitative multiple case-study research on primary school competence and confidence level regarding the use of ICTs in Teaching practice conducted in five European countries. Peralta &Costa (2007) found that technical competence influenced Italian teacher's use of ICTs in Teaching. However, the teachers cited pedagogical and didactic competences as significant factors if effective and efficient educational interventions are likely to be implemented. According to Peralta & Costa (2007) teachers with more experience with computers have greater confidence in their ability to use them effectively. To conclude, Jones (2004) reported that teachers competence relate directly to confidence. Teachers' confidence also relate to their perceptions of their ability to use computers in the classroom, particularly in relation to their children's perceived competence.

The findings of the study conducted by Igomu and Solomon (2015) on Assessment of ICT Competence among Teachers of Federal Unity Colleges in North Central Geo-political of Nigeria revealed that the competency level of FUC teachers is low and majority of FUC teachers cannot utilize ICT in teaching their subjects. Most teachers have personal computers/laptops but have little or no competence in the usage of ICT. It is apparent that the main skill acquired by the teachers is in Word processing which can be attributed to typing of examination, test questions, student record and so on by the teachers Singh and Chan (2014) on their study title Teacher Readiness on ICT Integration in Teaching and Learning. The study found that the teachers' level

of knowledge on ICT is moderate as they were only good at using certain applications such as spread sheet, presentation software and e-mailing as these are the main applications which are commonly and often used in the Teaching profession. Similarly, Kayode, Ngozi and Irene (2014) on their study title Competencies of Nigerian Graduate Teachers: The Insiders' Perspectives. The findings of their study found that teachers possess low competence in ICT skills. The results also indicated that there is no significant difference in the perceptions of graduate teachers and educational administrators on the competences of graduate teachers in areas of pedagogical, communicative, and ICT skills. Another study conducted by Andoh (2012) 0n Exploration of Teachers' Skills, Perceptions and Practices of ICT in Teaching and Learning in the Ghanaian Second-Cycle Schools. The study revealed that majority of teachers was moderately competent in word processing. Moreover, in a study conducted by Onasanya, Shehu and Oduwaiye (2010) found that the level of competences and skill acquisition of colleges of education and polytechnics lecturers in the use of ICTs facilities and equipment is worrisome in Nigeria. Another study conducted by Khalid (2009) found the following lack of confidence, lack of competence and lack of access to resources as the major barriers to successful integration of ICTs in content delivery.

A study conducted by Danner and Pessu (2013) on A Survey of ICT Competencies among Students in Teacher Preparation Programmes at the University of Benin, Benin City, Nigeria. The study revealed that competent deficiency exists among student in teacher preparation programmes. In a study conducted by Oyeronke and Faghabun (2013) on Assessment of Computer and ICT Skills Among Secondary School Teachers in Ota Ogun State, Nigeria. The study found that majority of the teachers in the Secondary Schools sampled were computer and ICT literate. Another study conducted by Andoh (2012) on An Exploration of

Teachers' Skills, Perceptions and Practices of ICT in Teaching and Learning in the Ghanaian Second-Cycle Schools. Results indicated that teachers' knowledge in basic ICT applications as well as integrating ICT into Teaching and learning processes was low. These results provide evidence that the introduction of ICT in Teaching and learning has not brought any change in the delivery of education in second-cycle Schools in Ghana. This also implies that teachers have not shifted from teacher-centered instruction to student-centered learning.Similarly, Yusuf and Balogun (2011) conducted a study on Student-Teachers' Competence and Attitude towards Information Communication Technology in Nigerian University. The study found that majority of the student teachers is competent in the use of few basic ICT tools like internet browsing, Microsoft office word etc. Omoniyi and Quadri (2010) conducted a study on Perceived Competence of Nigerian Secondary Schools Teachers in the Use of Information Communication Technology (ICT). The study found thatmost teachers in Ogun State Secondary Schools do not have the required competence in ICT.

All these findings were made in other places, but not in Kano metropolis. For that, the researcher rationally set out to examine whether public Senior Secondary Schools Biology teachers have competence of utilizing ICTsin Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

2.9 Gender Variation in the Use of ICTs

The term gender could be seen as a social attribute and opportunity associated with being a male and a female and the mutual relationship between them. These attributes and relationship are socially constructed and are learned through socialization processes, while technology development serves as a forum for exploring the linkage between changing gender relations and technological development (Ewhrudjakpor, 2006). Gender differences and the use of ICT have

been reported in several studies. However, studies concerning teachers' gender and ICT use have cited female teachers 'low levels of computer use due to their limited technology access, skill, and interest (Volman& Van Eck, 2008). The finding of the study conducted by Kay (2006) revealed that male teachers used more ICTs during teaching and learning processes than their female counterparts(Jamieson, Burnett, Finger & Watson, 2006) conducted a study on teachers‟ integration of ICTs in Schools in Queensland State. The finding of the study results from 929 teachers indicated that female teachers were integrating technology into their teaching less than the male teachers. However, some studies revealed that gender variable was not a predictor of ICT integration into Teaching (Norris, Sullivan &Soloway, 2003). Osuafor and Ofor (2015) conducted a study on Influence of Gender and Subject Specialization on Science Educators' Use of E-Learning Facilities for Teaching in Nigerian Colleges of Education. The overall mean rating of male and female educators' utilization of e- learning facilities for Teaching showed that the female mean rating (2.60) is slightly higher than that of males (2.55) though the difference was not significant. Both groups utilize the e-learning facilities to a moderate extent.

Mahmoud and Bokhari (2012) on their study titled "Use of Information and Communication Technology": Gender Differences among Students at Tertiary Level. The results of the analyzed data revealed that gender differences existed regarding access to ICTs among university students. Markauskaite (2005) Exploring differences in trainee teachers ICTs literacy: Does gender matter? No significant differences were found between females and males previous experience with ICTs. However, males on average worked with computers significantly more hours per week than females. Significant differences between males and females technical ICTs capabilities and situational and longitudinal sustainability were observed. Male's scores were higher than the female's score. Ogunlade, Fagbola, Ogunlade and Amosa (2015) conducted

a study on Assessment of Utilization of Internet Facilities Among Pre-Service Teachers in University of Ilorin, Nigeria The results shows that: 80% of the respondents had a positive attitude toward the use of internet facilities, 62% agreed that males were more internet literate; and there was no significant difference between male and female in the use of internet facilities.

2.10 Challenges Faced by Teachers towards Access and Use of ICTs

The use of ICTs in education has the potential to improve the quality of instruction, the research productivity of teachers and students, and the management and effectiveness of institutions (Kashorda, Waema, Omosa &Kyalo, 2007). However, opportunities for realizing the benefits of using ICTs in education face a number of challenges in the developing countries. Access to ICTs facilities is a major challenge facing most African countries, with a ratio of one computer to 150 students against the ratio of 1:15 students in the developed countries (Kashorda et al. 2007) .Apagu and Wakili (2015) conducted a study on Availability and Utilization of ICTs Facilities for Teaching and Learning of Vocational and Technical Education in Yobe State Technical Colleges. The study revealed irregular power supply; inadequate computer literate teachers; inadequate ICT facilities as challenges facing teachers towards utilization of ICTs.

Challenges such as: inadequate trained personnel to the use of ICTs, lack of computers, broken down computers, lack of electricity, burglary and lack of internet or slow connectivity in most Nigerian higher institutions were also identified by Aduke (2008); while inequality to access of e-learning was also pointed out by Arikpo, Osofisan and Usoro (2009). Another study `conducted by Amuchie (2015) Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo, Taraba State. The findings revealed that poor power supply, Lack of adequately trained teachers in the use of ICTs in Teaching, high cost of computers and accessories among others are the constraints towards effective utilization

of ICTs in Teaching and learning. In a study conducted by Ajayi, Ekundayo and Haastrup (2009) on the application of Information and Communication Technologies in Nigerian Secondary Schools found that, the major challenge facing the adoption of ICTs in Nigerian Secondary Schools is irregular power supply with (98.1%) respondents. Another challenge facing the adoption of ICTs in Teaching is lack of computer literate teachers with (89.4%) respondents. Other major challenges are lack of fund in Schools with (84.7%) and inadequate facilities to support the application of ICTs with (82.2%) respondents.

Suleiman (2012) found these obstacles as major challenges faced by teachers in accessing and utilizing ICTs.

(a) High cost of hardware such as bigger bandwidth and other internal gadgets like smart boards.

(b) Transmission cost is also high.

(c)Insufficient internet access Internet access

(d) Dearth in skilled manpower for implementation and management.

(e) Inadequate training of staff in institutions especially related to educational technology.

(f) Poor condition of telecommunication infrastructure.

(g) Low literacy level in computer technology among teachers.

(h) Cost of acquiring and installation of the gadgets required for e-learning.

(i) Inadequate electricity supply all over.

(j) Deficit in having well furnish/equipped e-learning centers.

(k) Faithlessness/ trustworthiness.

The World Bank (2009) conclusively, declared also that many Nigerian institutions are faced with challenges of inadequate ICTs infrastructure, high cost of bandwidth access, lack of skilled manpower, inadequate training facilities, resistance to change from traditional

pedagogical methods to more innovative, underfunding among others. In other countries, e-learning innovations are believed to have advanced so fast especially in Asian countries. However, in Nigeria, this setback in innovations has affected so many ways instructions are implemented.

2.11Review of Empirical Studies

Several empirical studies related to this study were reviewed. The empirical studies reviewed revealed that most of the required ICTs facilities are not available in schools for teachers to access and utilize them during instruction and this consequently leads to low level of ICTs competency among teachers in public senior secondary schools. It is clear that CTs competency among teachers in secondary schools depends largely on the availability, access and use of such ICTs facilities.

Singh and Chan (2014) conducted a study on Teacher Readiness on ICTs Integration in Teaching-Learning: A Malaysian Case Study. The purpose of the study was to investigate the knowledge level, attitude towards the use of ICTs in Teaching-learning and obstacles faced by the in-service teachers in Secondary Schools. Descriptive survey design was employed. The population comprises of all 50 teachers in a Secondary school in the state of Penang. The instrument used to collect data was questionnaire and the data obtained was analyzed using a simple percentages. The results from the study revealed that teachers' level of knowledge on ICTs is moderate as they were only good at using certain applications such as spread sheet, presentation software and e-mailing. The finding concerns about the use of ICTs in Teaching-learning process by teachers also revealed that more than half of the respondents often used ICTs to teach computer skills, do presentations, communicating with other teachers, monitoring and evaluating students' progress or keeping track of students' performance and preparing reports.

Finally, the study revealed the following as challenges faced by teachers when utilizing ICTs; lack of time in the school to use ICTs as they are burdened with other responsibilities, Lack of technical support and lack of tools and knowledge on how to make full use of ICTs. It is recommended that Teachers in Malaysia need intensive training in the use of Information technology (IT) to facilitate its integration into classroom activities in ways that enhance thinking and creativity. The teachers also need to learn how to facilitate and encourage students to take charge of their own learning.

Adelabu, Adu and Adjogri (2014) conducted a study on The Availability and Utilization of E-Learning Infrastructures for Teaching and Learning in South Africa. The study investigated the availability and utilization of e-learning infrastructures for Teaching and learning at the University of Ibadan. Four research questions guided the study. The population of the study was made up of 482 students and 180 lecturers randomly selected from the four faculties of the institution. Data obtained was analyzed using mean and t-test. Some of the findings revealed that e- learning infrastructures are not adequately available in the higher institution of learning. Development of Information Communication Technology (ICTs) is mainly for administrative purposes. In addition, both lecturers and students have computers and laptops which could be used to access the internet but, they do not use them for Teaching and learning. Based on the findings of the study, recommendations were made to encourage the use of e-learning infrastructures to foster Teaching and learning in the university. The university should as matter of urgency organize in house training for lecturers on the use of ICTs for Teaching and learning. Government should release the necessary funds to enable universities put in place necessary ICTs infrastructures that will facilitate Teaching and learning.

Mavellas, Wellington and Samuel (2016) conducted a study on availability of common educational Information Communications Technologies (ICTs) in Secondary Schools, using a high school in Kwekwe, Zimbabwe as a case study. Such Technologies include computers, radios, televisions, networks, wireless Technologies, interactive boards, internet, email, eLearning applications, video conferencing and projectors, among others. It further assessed whether the available ICTs are being utilized by teachers and students, looking at such usage activities as preparation for lessons, lesson delivery, issuing of assignments, research and Communications. The research further identified the factors that are hindering the ICTs utilization in these Schools. Qualitative research designed was employed and a population of 51 teachers out of which 45 teachers was selected to represent the sample size. The instrument used to collect the data was a self designed questionnaire and the data obtained were analyzed using frequency counts and simple percentages. The findings of the study revealed that ICTs resources are not available, ICTs utilization is to a very low extent and the following were among the constraints hindering teachers from utilizing ICTs; lack of power supply, insufficient resources, fear of technology, lack of interest, ICTs skills deficiency, higher ICTs cost and poor physical infrastructure. Recommendations were put forward on how to improve ICTs availability and utilization at the school and Schools in general for the betterment of Teaching and learning.

Arabu, Mwangi and Obara (2015) conducted a study on Relationship between Competence and Use of Information and Communication Technologies (ICTs) in Classroom Instruction by Secondary School Agriculture Teachers in Nyamira County, Kenya. The study was purposely to determine the relationship between competence and use of ICTs in classroom instruction by Secondary school agriculture teachers in Nyamira County, Kenya. Descriptive survey design was employed for the study. The target population comprised 215 Secondary

school agriculture teachers from the five Sub-counties of Nyamira County. Proportionate to size, stratified random sampling was used to obtain a sample size of 120 respondents. A semi-structured questionnaire was used for data collection. The reliability coefficient of the instrument was found to be $\alpha = 0.77$ which was above the 0.70 threshold acceptable reliability. Descriptive and inferential statistics (Pearson's Product Moment Correlation) were used for data analysis. Statistical Package for Social Sciences (SPSS) version 20 was used in analyzing data and all tests were computed at $\alpha=0.05$. The study established a significant relationship between teachers' ICTs competence and the use of ICTs in classroom instruction ($r=0.52$; $p<0.05$). The study recommends that the Ministry of Education and school administrators should provide ICTs resources to Schools and also provide training opportunities and support to teachers for effective use of ICTs in classroom instruction.

Andoh (2012) conducted a study on An Exploration of Teachers' Skills, Perceptions and Practices of ICT in Teaching and learning in the Ghanaian Second-Cycle Schools. The study was conducted to explore teachers' skills, perceptions, and practices about ICTs in second-cycle institutions in Ghana. Questionnaire was the instrument used for the study which comprises of a population 273 teachers in different departments. 231 teachers were used to represent the sample size of the study. The validity of the questionnaire was approved by a panel of experts in the field. The Cronbach's alpha reliability coefficient was 0.91. Descriptive statistics and correlation were used to analyze data. Of the 231 teachers, 66% were males and 34% were females. Majority of the respondents were between the ages 30-39. The correlation analysis revealed positive correlation between ICTs use and teachers' competences. Further, teachers' perceptions in terms of using ICTs were found to be positive but not statistically significant. Finally, the study revealed inverse correlations among ICTs use, age, and Teaching experience. The

descriptive results indicated that teachers' knowledge in basic ICTs applications as well as integrating ICTs into Teaching and learning processes was low. These results provide evidence that the introduction of ICTs in Teaching and learning has not brought any change in the delivery of education in second-cycle Schools in Ghana. This also implies that teachers have not shifted from teacher-centered instruction to student-centered learning. From the findings of the study, it is recommended that courses such as computer supported learning, ICTs and designing instructional materials should be introduced in initial teacher training programs to improve teachers' level of confidence and perceptions towards the use of ICTs.

The study of Apagu and Wakili (2015) examines the availability and utilization, the benefits and challenges of ICTs facilities in Teaching and learning vocational and technical education in Yobe state technical college, Nigeria. Descriptive survey design was used for the study. Self-designed questionnaire tagged "ICTs in technical colleges, (ICTTC)". Mean and standard deviation was used to analyze the data. The findings of the study revealed that ICTs facilities were lacking in technical colleges. Teachers and Students exposure to ICT facilities was low. The study revealed that some of the benefits of using ICTs in technical college include making Teaching and learning interesting; helping teacher to be up to date in enhancing the quality of work of both teachers and students. Despite these benefits, the study revealed some of the challenges facing ICTs as: irregular power supply; inadequate computer literate teachers; inadequate ICTs facilities. It was therefore, recommended that Yobe state government should increase the funding of education sector to cater for ICTs programme in technical colleges and there should be periodic training for teachers on ICTs computer skills acquisition.

Amuchie (2015) conducted a study on Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo, Taraba State. The study

was designed to ascertain the various Information Communication Technology resources available for Teaching and learning in Secondary Schools in the two local government areas in Ardo kola and Jalingo, Taraba state. The population of the study comprises of all the Secondary school teachers and principals in all the forty Secondary Schools. 264 respondents were selected for the study using stratified - random sampling technique. The instrument used for the collection of data was a set of researcher made questionnaire. Data collected was analyzed using frequency counts and simple percentage. The result obtained from the data shows that the extent of availability of ICTs resources in Secondary Schools in Ardokola and Jalingo is very low. The extent of utilization of ICT resources in Teaching and learning is equally very low. ICTs resources were not available in the Schools for the use of teachers and students for learning activities. It was also found out that many factors were perceived by the teachers and principals as constraints to the effective utilization of ICTs in Teaching and learning in Secondary Schools. They include; poor power supply. Lack of adequately trained teachers to use ICTs in Teaching, high cost of computers and accessories among others. It was concluded that much has not been done by government in the area of provision of ICTs resources for Teaching and learning in this era of ICTs based learning. The paper recommends governments', non-governmental organizations' and private individuals' intervention in the provision of needed ICT resources in the Schools among others.

Akpan (2014) conducted a study on ICT Competence and Lecturers' Job Efficacy in Universities in Cross River State, Nigeria The study sought to find out the influence of ICT competence on lecturers' Job Efficacy in two Nigerian universities. Two hypotheses were formulated to guide the study. The sample of the study consisted of 500 university teachers randomly sampled from a population of 1,795 teachers. Data for the study were collected using

ICT Competence and Job Efficacy Questionnaire (ICTCJEQ). The data were analyzed using Chi-square and One-way Analysis of variance (ANOVA) statistical techniques. The results of the study revealed that male and female lecturers did not differ significantly in their level of ICT competence. Lecturers with high ICT competence were found to be more efficacious in classroom instruction, research/publication, Communication and record- keeping than those with moderate and low ICT competence. The findings of this study revealed that the level of ICT competence of lecturers significantly enhanced their job efficacy. Premised on these findings, it was recommended that lecturers should be well motivated to develop their ICT competence as this has been found to improve job efficacy for high productivity. University management should encourage lecturers to participate in ICT training programs and ICT facilities should be provided in lecturers' offices to enhance their job efficacy.

Eze and Aja (2014) conducted a study to assess the availability and utilization of Information Communication Technology (ICT) devices in Senior Secondary Schools in Ebonyi Local Government Area of Ebonyi State. Four research questions were developed to guide the study. The population of the study comprised of two hundred and twenty five (225) teachers and Eight thousand one hundred and twenty eight (8,128) students in the fifteen (15) Senior Secondary Schools in the study area. Simple random sampling technique was used to select ten (10) teachers and twenty six (26) students from ten (10) Schools used for the study to give a sample size of three hundred and sixty (360) respondents. The instrument used for data collection was structured questionnaire. Pearson's Moment Correlation Co-efficient was used to calculate the reliability co-efficient of the pilot tests to get established reliability value of 0.78. The data collected were analyzed using mean scores. It was found among other things that ICT devices are not adequately utilized, personnel to operate ICT devices are not adequately trained

and most of the ICT devices are not in good working condition in Schools studied. Based on the findings, the following recommendations were made: urgent review and implementation of policy on ICT adaptation in Secondary Schools, recruitment and posting of qualified personnel to operate ICT devices in Secondary Schools, review of teacher education curriculum to incorporate ICT skills and training and encouraging individuals and non governmental agencies to participate in the provision and maintenance of ICT devices.

Badau and Sakiyo (2013) conducted a study on Assessment of ICT Teachers' Competence to Implement the New ICT Curriculum in North Eastern Nigeria. This study assessed the competence of ICT of rural and urban Secondary school ICT teachers for the implementation of ICT curriculum in North Eastern Nigeria. The study looked at the competence of applying ICT technical literacy on the six components of teachers work in the Secondary Schools. All the one thousand, seven hundred and forty four (1,744) Secondary school ICT teachers from the six states of the North Eastern Nigeria participated in the study by responding to close ended questionnaire. The instrument sought Information on ICT teachers' policy, curriculum, pedagogy, technology, administration, professional development competences and obstacles to ICT teachers' competences. Data was analyzed thro ugh grand mean, standard deviation and percentage. Results reveal that the competence of ICT teachers on policy, curriculum, pedagogy, technology, administration and professional development is low. Obstacles to ICT teachers' competences were identified as lack of hardware, software, and financial resources, lack of electricity in most rural Schools and insufficient Information and experience from teachers in ICT applications. It was recommended among others that ICT should be incorporated in the professional development of teachers and ICT curriculum should be robust enough to enhance teachers' job performance in Schools.

Jegede (2013) conducted a study on students' Perception of the Availability and Utilization of Information Communication Technology (ICT) in the Teaching and Learning of Science Subjects in Secondary Schools in Ekiti State, Nigeria. The study investigated students' perception of the availability and utilization of Information Communication Technology (ICT) in the Teaching and learning of science subjects in Secondary Schools in Ekiti State, Nigeria. The population of the study was made up of all Secondary school students in public and private Secondary Schools in Ekiti State, Nigeria. The sample was 400 students selected from both public and private Secondary Schools in the state using the multi-stage sampling. The only instrument used in collecting relevant data for the study was a questionnaire consisting of two sections A and B. Section A consisted of personal biodata of the respondents, while section B consisted of 22 items which elicited Information on the application of ICT in Schools for learning science. Four research questions were raised and two hypotheses tested. Data collected were analyzed using frequency counts and percentages as well as inferential statistics of t-test. The results showed that apart from the computer, which is available in most Schools, the other identified ICT equipment were not available. The findings also showed that there is no significant difference in the availability of ICT facilities in public and private Secondary Schools, and that students in private Schools are more exposed to ICT than their counterparts in public Schools.

Ajayi, Ekundayo and Haastrup (2009) conducted a study on "The application of Information and Communication Technologies in Nigerian Secondary Schools in Ondo and Ekiti state of Nigeria". The study investigated the level of availability of ICTs facilities in Schools, the capacity for using ICT resources for Teaching and learning by teachers, the perceived benefits of using ICTs by teachers and the constraints faced by instructors in the use of ICT in Secondary

Schools. Descriptive survey design was employed for the study. All the teachers and principals of the Secondary Schools in Ondo and Ekiti States were used for population of the study. The sample of 320 teachers and 40 principals were randomly selected from each of these Secondary Schools in Ondo and Ekiti States. A self-designed questionnaire tagged "ICT" and Secondary Schools (ICTSS)" was used to collect the data for the study. Data collected for the study were analyzed using frequency counts and percentage scores. Findings of the study revealed that ICTs facilities were lacking in Schools and teachers and students were to a little extent exposed to the use of ICTs. Moreover, the study revealed the perceived benefits of using ICTs in Schools which include making Teaching-learning interesting; helping the distance learning programmed; helping teachers to be up-to-date; enhancing quality of work by both the teachers and the students. However, despite these perceived benefits, the study also revealed some of the challenges facing ICTs in Secondary Schools as: irregular power supply: inadequate computer literate teachers; high cost of purchasing computers in Schools; inadequate facilities to support full application of the ICTs and lack of fund. The study recommended that government should increase the funding of the education sector. There should also be periodic training for teachers on computer and ICTs skills acquisition.

Similarly, Agbulu and Ademu (2010) conducted a study on "Assessment of Agricultural Science Teachers' Knowledge and Utilization of Information and Communication Technologies in Nigerian Secondary Schools". The study examined the availability of Information and Communication Technologies in Secondary Schools, knowledge of Information Communication Technology possessed by agricultural science teachers; utilization of Information Communication Technology by agricultural science teachers for Teaching-learning and the challenges posed by Information Communication Technology to agricultural science teachers.

Four research questions were structured and two hypotheses were tested at 0.05 level of significance. A survey research design was adopted for the study. A total of 420 Agricultural science teachers were used to obtain Information. A checklist and structured questionnaire with five points rating scale was used for data collection. The reliability coefficient of the instrument was obtained by using Cronbach Alpha with a value of 0.83. Mean and Standard deviation were used to analyze the data collected. The results of the analyzed data revealed that Information Communication Technology was not utilized during instruction in Secondary Schools. The study recommended that training of agricultural science teacher should be reviewed to emphasize knowledge and skills related to the use of Information and Communication Technologies for Teaching and learning of agricultural sciences in Secondary Schools.

Egomo, Enyi and Tah (2012) conducted a study on "Availability and utilization of ICTs tools for effective instructional delivery in tertiary institutions in Cross River State, Nigeria". The study accessed availability and extent to which ICTs facilities are utilized for effective instructional delivery in tertiary institutions in Cross River State. Simple random sampling was used in which 300 lecturers were selected for the study. Four research questions were formulated to guide the study. A questionnaire titled: Availability and Utilization of ICTs tools for effective instructional delivery in tertiary institutions in Cross River State was the only instrument used for data collection (ICTTEIDQ). The items on the questionnaire were statistically analyzed using simple percentage. The results obtained from the analysis revealed that availability and utilization of ICTs tools for effective instructional delivery is significantly low. Cyber Cafes, internet connectivity and use of lap tops is a common phenomenon among institutions and lecturers. Competence in the use of ICTs tools among lecturers is discouraging. However, lecturers' from University of Calabar differed significantly with their counterparts from Nuga

Poly and COE in terms of utilization and competence of ICTs tools. Recommendations were made to enhance the provision and utilization of ICTs tools in tertiary institutions in Cross River State.

Another study conducted by Jude and Dankaro (2012) on "ICT Resource Utilization, Availability and Accessibility by Teacher Educators for Instructional Development in College of Education katsina-Ala, Benue state. Nigeria". The study enquired the utilization of ICTs in the instructional mix by teacher educators in College of Education (COE) Katsina-Ala, Benue state, Nigeria. A total of forty COE Katsina-Ala teacher educators from 5Schools were randomly selected to form the sample size from a population of 287. The researchers adopted the Ex post Facto research design and formulated two research questions to guide him in conducting the study. The researcher developed an instrument tagged Information Communication Technology Questionnaire (ICTRQ) for data collection. The reliability co-efficient obtained for the instrument was 0.71. The data was subjected for analyses using frequencies and percentages. The findings from the analysis revealed that ICTs resources were not available and for that reason, teacher educators could not access them for instructional delivery. Recommendation was made on the college authority that they should benefit teacher educators in the institution with ICTs resources and sponsor them on training and retraining programmed to produce ICTs compliant products. Fagbohun and Oyeronke (2013) conducted a study on an "Assessment of Computer and ICTs Skills among Secondary School Teachers in Ota Ogun State" the study aimed to find out if the teachers were computer and ICTs literate and to examine if they employ computers and ICTs during class instruction. Eighty copies of a self-designed questionnaire were administered to teachers in four Secondary Schools, out of which sixty eight was completed, returned and found usable. The finding of the study shows that the respondents are aware of the fact that being

computer and ICTs literate is very important in their profession. The paper concludes that the Government in conjunction with the Ministry of Education inculcates computer and ICTs training into the curriculum of teacher training Schools. It also admonishes the Nigerian Library Association (NLA) to rise to the occasion of reviving and establishing school libraries in Secondary Schools.

In a study conducted by Zubairu (2014) on "assessment of availability, accessibility and utilization of Information and Communication Technologies (ICTs) in content delivery among lecturers in federal colleges of education in Nigeria" where eight research questions and two hypotheses were drawn to guide the study. A Survey research design was used to conduct the study. The population of the study comprises of all the lecturers in Federal Colleges of Education in Nigeria. They are five thousand and seventy one (5,071) in number. A sample size of eight hundred and forty three (843) lecturers was used for the study; cluster, simple random and proportional sampling techniques was used. A modified questionnaire tagged Teachers ICTs usage survey from the ICT Survey Indicator for teachers and staff developed by both UNESCO (2004) and the New Zealand Ministry of Education (1999) was used for data collection. The questionnaire was designed under seven (7) different sections and harmonized in one single questionnaire. Percentage was used to analyze and interpret the demographic data of the respondents of the study, while frequency count was used to answer research questions 1-6 and descriptive statistics was used to answer research questions 7and 8 respectively. Independent t-test statistics was also used to analyze research hypothesis 1 using mean and standard deviation, while one way ANOVA was used to answer hypothesis 2 using sum of square, degree of freedom, mean of sum of square, and were tested at $p<0.05$ level of significance using statistical package for social science SPSS). The two null hypotheses were rejected. The findings of the

study revealed that ICTs resources are not available in Federal Colleges of Education in Nigeria. It was also revealed that ICTs resources which were supposed to be used in content delivery by lecturers in FCE were not accessible and also lecturers were not exposed and proficient in using ICT resources. This study also confirmed that the major challenge facing lecturers in using ICTs is the irregularity in power supply. The study recommends, among others, that the Government, NCCE and the managements of FCE should cooperate together and ensure that computer laboratories are available in FCE with adequate functional computer hardware and software and functional internet facilities that will cater for the need of both staff and students. Furthermore,

Despite the above conducted research studies, this research study is to be conducted on availability, access and use of ICTs in Teaching of Biology in public Senior Secondary Schools in Kano metropolis.

2.12 Uniqueness of the Study

Many research studies on ICTs have been conducted by several researchers in different part of Nigeria and also in outside Nigeria. Though, researches have not been found on Availability, Access and Use of ICTs in Teaching of Biology in Kano metropolis. The uniqueness of this research study is that, the study was conducted in public Senior Secondary Schools in Kano metropolis.

2.13 Implication of the study

This chapter reviewed related literature on the concept of Information and Communication Technologies, history to the emergence of ICTs in Nigeria, ICTs and education, availability, accessibility and use of ICTs by teachers, teachers' competence on ICTs, and challenges faced by teachers towards accessing and utilization of ICTs. Most of the empirical studies reviewed hold that the availability, accessibility of ICTs tools for Teaching could be of great help to

teachers in the context of instruction. According to Yildrim (2007) access to technological resources is one of the effective ways to teachers' pedagogical use of ICTs in Teaching. Effective adoption and integration of ICTs into Teaching in Secondary Schools depends mainly on the availability and accessibility of ICTs resources. Therefore, by virtue of the relevance and benefit of ICTs in context of instruction, it is required that, ICTs facilities are made available in public Senior Secondary Schools to enhance effective Teaching and learning, particularly the Teaching of Biology. From the literature reviewed, it is clear that several studies found that ICTs resources are not available and accessible by Secondary school teachers in Nigerian public Senior Secondary Schools. Studies have also shown that teachers are not well competence in the use of ICTs facilities in Teaching and learning activities.

However, none of the literature reviewed sought to find out the level of availability, accessibility and use of ICTs resources in Kano metropolis. This study is designed to fill this gap in the literature so as to provide useful Information in such area in Kano metropolis.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

In this chapter the researcher discussed the method, procedures and techniques used during the conduct of this research study. Specifically, it deals with the research design, population and sample size of the study, sampling technique, data collection instrument, validity and reliability of the instrument, procedure for data collection, as well as data analysis.

3.2 Research Design

Descriptive survey design was employed for this research. Descriptive survey research helps the researcher to gather Information on Availability, Access and Use of Information and Communication Technologies in the Teaching of Biology in public Senior Secondary Schools in Kano metropolis. It is also employed in order to describe the nature of the existing conditions of public Senior Secondary Schools concerning Availability, Access and Use of ICTs for Teaching of Biology. A descriptive survey research is a type of research that employs application of scientific method by critically analyzing and examining the source of materials, by analyzing and interpreting data and by arriving at generalization (Neeru, 2012).

3.3 Population and Sample Size of the Study

3.3.1Population of the Study

The population for this study comprises of all Biology teachers in public Senior Secondary Schools in Kano metropolis. Eight local government areas are found within Kano metropolis among which include: Dala, Fagge, Gwale, kumbotso, Municipal, Nassarawa, Tarauni, and Ungoggo. The Biology teachers are spread all over the Senior Secondary Schools

that are within the eight local government areas. They consisted of two hundred and eighteen (218) Biology teachers. The distribution of the target population is presented in the table 3.1 as follows:

Table 3.1: Number of Public Senior Secondary Schools and Biology Teachers in Kano Metropolis

Local Government	Number of schools	Number of Biology teachers	Males	Females
Dala	16	21	08	13
Fagge	17	22	10	12
Gwale	19	30	0 8	22
Kumbotso	27	20	10	10
Municipal	24	39	13	26
Nassarawa	28	56	20	36
Tarauni	17	23	10	13
Ungoggo	16	07	04	03
Total	**164**	**218**	**83**	**135**

Source 1: Kano state Senior Secondary Schools management board (KSSSMB) department of planning, research and statistic, 2015.
Source 2: Science and Technical Schools board (STSB) Kano state, 2015.

3.3.2 Sample Size

There are total numbers of one hundred and sixty four (164) public Senior Secondary Schools in Kano metropolis. The researcher sample four (4) local government areas from the population of eight local government areas. The study comprises of a total number of sixty five (65) Biology teachers who are from the sample LGAs, from a total number of two hundred and eighteen (218) Biology teachers of the whole Public Senior Secondary Schools of the LGAs. For the researcher to obtain an acceptable sample size, Krejcie and Morgan statistical table was used

to determine the sample size of the study, in which according to Krejcie and Morgan table, when the population is sixty five (65), then the sample size will be fifty eight (58). Therefore, fifty eight (58) Biology teachers were selected to represent the sample size of the population.

Table 3.2: Distribution of Sample from the Population of Public Senior Secondary Schools In Gwale, Municipal, Nassarawa and Fagge in Kano metropolis

Local government	Number of Biology Teachers	Sample size
Gwale	15	14
Municipal	13	10
Nassarawa	10	10
Fagge	27	24
Total	**65**	**58**

Source:Krejcie& Morgan (1970).Table for Determining Sample Size

3.3.3 Sampling Technique

Cluster sampling technique was used to select four local government areas from eight LGAs of Kano metropolis.The choice of clustering is that the sample are from naturally occurring group (cluster) and they are of the same kind but are found in a closely different location and there is also inclusion of all members of the cluster. Then simple random sampling technique was used to select four Secondary Schools from each local government. A hat and draw form of simple random sampling technique without replacement was employed, where a piece of paper carrying YES or NO was used to select the number of Schools from which the sample size was drawn. According to Neeru (2012) Sampling is the process by which a relatively small number of individual, object or event is chosen and analyzed in order to find out something about the entire population from which it was chosen. It provides generalization of the whole population. The distribution of the Schools and number of Biology teachers in Gwale, Municipal, Nassarawa and Fagge LGAs can be seen in the table as follows:

Table 3.3 Distribution of Sample Schools and Biology Teachers in Gwale, Fagge, Municipal and Nassarawa Local Government area of Kano metropolis

LOCAL GOVERNMENT	SAMPLE SCHOOLS	BIOLOGY TEACHERS
GWALE	GGC KANO	06
	GSS GWAMMAJA	03
	GSS GWALE	03
	GGSS DUKAWUYA	03
FAGGE	DAY SCIENCE COLLEGE	06
	GC KANO	11
	GSTC KANO	08
	GSS MAIKWATASHI	02
MUNICIPAL	GGSS GANDUN ALBASA	03
	GSS K/NASSARAWA	03
	GSS SABUWAR KOFA	04
	GSS SHARADA	03
NASARAWA	GSS HOTORO NORTH	03
	GGSS DAKATA	03
	GGSS GIGINYU	02
	GSS STADIUM	02
TOTAL		**65**

Source 1: Kano State Senior Secondary Schools Management Board (KSSSSMB).
Source 2: Science and Technical Schools board (STSB) Kano state, 2015.

3.4 Data Collection Instrument

The instrument used for the collection of data for this study was checklist and questionnaire. Questionnaire tagged ICT and Federal Colleges of Education Lecturers Questionnaire (ICTFCELQ) was adapted for this study from Sulaiman (2014). The questionnaire has seven sections. Section A is for demographic data while section B-G was on Assessment of Availability, Accessibility and Utilization of Information and Communication Technology (ICT) Resources in Content Delivery among Lecturers in Federal Colleges of Education in Nigeria. It has 3 rating scale and contains the following items; computer hardware, computer software,

integrated services digital network, smart board, learning management system, servers/hubs, data projector, digital camera, TV/Radio etc.

The researcher makes modifications on the questionnaire and it was designed with all the necessary Information that will make the respondents to respond to it appropriately. It was also designed on a four point rating scale type (4, 3, 2 and 1) in which the respondents were allowed to choose from the options provided. The Respondents were required to respond to the items by a tick (√) against the appropriate option that reflect or show their personal opinion. The questionnaire has five sections (A-E). Section A requires demographic data of the respondents on gender i.e. Male or Female. Section B requires Information on access to ICTs by Biology teachers, section C requires Information on utilization of ICTs, section D requires Information on competence and section G requires Information on challenges facing Biology teachers when accessing and utilization of ICTs.

3.5 Validity and Reliability of the Instrument

3.5.1 Validity of the Instrument

The adapted instrument was taken for face and content validation. Content validity is when a question adequately reflects the underlying behavior or body of knowledge. Content validity is established by having experts evaluate the relevance of the test items (Orodho, 2008). For this research instrument to be valid, to measure what it is supposed to measure, the instrument was assessed by two Senior Lecturers with a rank of Ph.D from Science and Technology Education Department, Bayero University Kano and one Assistant Professor from Applied Biology Department of the same university. The purpose of validating the instrument was to check the instrument of any unclear direction, vocabulary and sentence structures that might be too difficult, poorly constructed items, improper arrangement of items and ambiguous

test items inappropriate for the outcomes to be measured. As Nworgu (1991) states that, for instrument to be validated, it has to be given the services of a panel of experts who are to ensure that the items correspond with the purpose of the study, research questions as well as hypotheses if any to be tested. The observations made by the validators were that the items in the questionnaire were appropriate to be used to conduct the research considering the research topic. Also any grammatical errors observed were corrected.

3.5.2 Reliability of the Instrument

To measure the consistency of the instrument, pilot study was carried out in a two weeks interval using test-retest method where by thirty questionnaires were pilot tested in some public Senior Secondary Schools that were out of the sample of this study in Kano metropolis, to ascertain the reliability of the characterictics of the content of the items in the instrument wether there is difficulty or any ambiguity. Pearson product moment correlation coefficient was used to analyze the reliability coefficient of the result obtained from the checklist in which a reliability coefficient of 0.89 was obtained.

3.6 Data Collection Procedure

Letter of Introduction was obtained from the Department of Science and Technology Education Faculty of Education, Bayero University Kano. In order to pave way for the researcher to the Schools to be visited to access valuable and relevant Information, the researcher visited the Schools personally with the Letter of Introduction to facilitate ease when it comes to administering the questionnaire. Upon obtaining Schools consent, the researcher seeks the help of research assistants (HOD Biology) who helped the researcher to administer the questionnaires to the respondents and ensure that the questionnaires were duly returned by the respondents. The questionnaires were distributed within four weeks after which the researcher revisited the schools

and collected the questionnaire. Out of 58 questionnaires administered one of the questionnaire got missing in which only 57 questionaires were returned to the researcher.

3.7 Data Analysis Procedure

The data collected was analyzed by using a number of statistical techniques including frequency counts and percentages, mean and standard deviation and t-test Independent. Frequency count and percentage was used to analyze demographic data of the respondents. Frequency count and percentage was used also to analyze the checklist to answer research question one on Availability of ICTs for Teaching of Biology in Public Senior Secondary Schools. Mean and standard deviation was used to analyze research question 2-5 with a decision rule cut off point of 2.50. For items in research question 2 on access to ICTs by Biology teachers, any item with a mean score cut off of 2.50 and above was considered accessible and below 2.5 was considered not accessible.For items in research question 3 on extent of utilizing ICTs by Biology teachers, any item with a mean score cut off of 2.50 and above was considered high extent, but below 2.50 was considered low extent.For items in research question 4 on competence of utilizing ICTs by Biology teachers, any item with a mean score of 2.50 and above was considered competent,and below 2.50 was considered low competent.For items in research question 5, any item with a mean score of 2.50 and above was considered agree, but below 2.50 was considered disagree. And t-test independent was used to analyse the research hypothesis which stated that there is no significance gender difference among Biology Teachers in ICTs competency in Public Senior Secondary Schools in Kano metropolis.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the result of the data obtained from the findings of the study, analysis of the data as well as discussion of the major findings.

4.2 Data presentation and analysis

The presentation and analysis of the data were based on the research questions, checklist, and the null hypothesis stated in chapter one of the study. In this study, the results obtained from the data collected were coded and analyzed using version 20 of statistical package for social sciences (SPSS) and are presented in the following tables:

4.2.1 Demographic data of the respondents

The frequency and percentage of demographic data of the respondents is presented in table 4.1 as follows;

Table 4.1: Frequency and Percentage distribution of the respondents by gender

Respondents	Frequency	Percentage
Male	25	43.9%
Female	32	56.1%
Total	**57**	**100.00%**

The data in table 4.1 on the distribution of the respondents by gender shows that out of 57 respondents: 25 respondents with 43.9% are male while 32 respondents with 56.1% are female. This means that majority of the respondents which took part in the study were female Biology teachers.

4.2.2 Research questions

Research question 1: Arepublic Senior Secondary Schools in Kano metropolis provided with available Information and Communication Technology facilities for the Teaching of Biology?

To answer this research question, checklist was used to rate the ICTs tools that are available in public Senior Secondary Schools for Teaching of Biology. The result is presented in table 4.2 as follows;

Table 4.2: Checklist for Determining Availability of ICTs for Teaching Biology in Public Senior Secondary Schools

Items	Available		Not available		Total	Total
	F	%	F	%	F	%
Desktop computer	1	6.30	15	93.8	16	100%
Laptop computer	2	12.5	14	87.5	16	100%
Interractive white board	0	0.00	16	100	16	100%
Projectors	6	37.5	10	62.5	16	100%
Digital camera	1	6.30	15	93.8	16	100%
Television	0	0.00	16	100	16	100%
DVD player	0	0.00	16	100	16	100%
Internet facilities	0	0.00	16	100	16	100%

Table 4.2 results on the checklist for determining availability of ICTs facilities in public Senior Secondary Schools in Kano metropolis shows that the percentage of the responses which indicated non availability of all ICTs facilities in the checklist is higher in number than those

indicated available. This result clearly shows that ICTs facilities specifically for Teaching of Biology are not available in public Senior Secondary Schools in Kano metropolis.

Research Question 2: Are ICTs materials easily accessible by teachers whenever they intend to use them for Biology class instruction?

To answer this question, respondents were asked to rate themselves on the items provided on ICTs facilities accessible to them whenever they intend to use them for the Teaching of Biology. The purpose of using mean and standard deviation was to ascertain the mean score of the types of ICTs that are easily accessible and used by teachers in Biology instruction on a four rating scale. The decision rule drawn was a mean score cut off point of 2.50. Implying that all items with a mean score of 2.50 and above is considered accessible, and below 2.50 is considered not accessible. The result is presented in table 4.3 as follows;

Table 4.3: Teachers' response on the accessible ICT facilities for Biology class instruction

Items	Mean	Stdrd.Dev.	Total	Decision
Dessktop computer	1.96	0.801	57	Not accessible
Laptop computer	2.04	0.823	57	Not accessible
Interactive white board	1.98	0.916	57	Not accessible
Projectors	2.00	1.035	57	Not accessible
Digital camera	1.40	0.776	57	Not accessible
Television	1.44	0.820	57	Not accessible
DVD player	1.72	0.861	57	Not accessible
Internet facilities	1.81	0.718	57	Not accessible

Table 4.3 results on teachers' responses on accessibility of ICTs facilities for Biology class instruction shows that the mean score of all items is below 2.50. Desktop computer has a mean score of 1.98, laptop computer 2.04, Interactive white board 1.98, Projectors 2.00, Digital

microscope1.63, Digital camera 1.40, Television 1.44, DVD player 1.72, and Internet facilities 1.81. This clearly indicates that ICTs facilities are not accessible in public Senior Secondary Schools. Biology teachers do not have access to any of these ICT facilities to deliver Biology instruction.

Research Question 3: Do Biology teachers utilizing ICTs resources during Biology class instruction?

To answer this question, on the extent of utilizing ICT facilities by Biology teachers in the Teaching of Biology mean and standard deviation was used to determine the mean score of the extent of utilizing ICTs by Biology teachers for Biology instruction on a four rating scale. The decision rule drawn was a mean score cut off point of 2.50. Implying that all items with a mean score of 2.50 and above is considered high extent, and below 2.50 is considered as low extent. The result is presentedin table 4.4 as follows:

Table 4.4: Mean and standard deviation of teacher's response on the extent of ICTs utilization for Teaching of Biology

Items	Mean	Stdrd. Dev.	Total	Decision
Desktop computer	2.07	0.821	57	Low extent
Laptop computer	2.05	0.895	57	Low extent
Interactive white board	1.86	0.718	57	Low extent
Projectors	2.39	1.031	57	Low extent
Digital camera	1.82	0.735	57	Low extent
Television	1.86	0.953	57	Low extent
DVD player	1.96	0.778	57	Low extent
Internet facilities	2.16	0.882	57	Low extent

Table 4.4 results on the extent of utilization of ICTs by Biology teachers for Teaching of Biology shows that the mean score of all items on the extent of utilizing ICTs for Teaching of

Biology is below 2.50.Desktop Computer has a mean score of 2.07, Laptop Computer 2.05, 2.39, 1.86, Projectors 2.39, Interactive white board 1.86, Digital microscope1.79, Digital camera 1.82, Television1.86, DVD player 1.96, and internet facilities 2.16. This means that the level of utilization of these ICTs resources by Biology teachers for the Teaching of Biology is to a low extent.

Research question 4: Do Biology teachers have competence of using ICTs resources for the effective Teaching of Biology?

To answer this question, mean and standard deviation was used. The reason of using mean and standard deviation was to determine the competence level of utilizing ICTs by Biology teachers for the Teaching of Biology on a four point rating scale. The decision rule drawn was a mean score cut off point of 2.50. Implying that all item with a mean score of 2.50 and above is considered competent, and below 2.50 1s considered as low competent. The result is presented in table 4.5 as follows;

Table 4.5: Mean and standard deviation of teacher's response on the level of ICTs competence for effective Teaching of Biology

Items	Mean	Stdrd. Dev.	Total	Decision
Internet browsing	2.77	0.866	57	Competent
Power point	2.26	0.897	57	Low competent
Microsoft office word	2.56	0.866	57	Competent
Excel	1.96	0.801	57	Low competent
Projectors	2.28	0.861	57	Low competent
Digital camera	1.95	0.811	57	Low competent
Scanning machine	2.19	0.934	57	Low competent
Printer	2.63	0.993	57	Cometent
DVD player	2.21	0.901	57	Low competent

Table 4.5 results on the level of ICTs competence among Biology teachers shows that the mean score of internet browsing (2.77), Microsoft office word (2.56) and printer (2.63) is above 2.50, meaning that public Senior Secondary Biology teachers are highly competent for utilizing such items for effective Teaching of Biology. Whereas the mean score of power point (2.26), excel (1.96), projectors (2.28), digital camera (1.95), digital microscope (2.23), scanning machine (2.19) and DVD/CD ROMS (2.21) is below 2.50, this means that public Senior Secondary Schools Biology teachers have low competence in utilizing such items for effective Teaching of Biology.

Hypothesis testing: There is no significance gender difference among Biology teachers in ICTs competency in Teaching Biology in public Senior Secondary Schools in Kano metropolis.

For this hypothesis testing, t-test statistics for independent sample (male and female) on the difference among Biology teachers in ICT competence in Teaching of Biology was used and the result is presented in table 4.6 as follows;

Table 4.6: t-test Statistics for Gender Difference on ICTs competence among Biology teachers in public Senior Secondary Schools

Gender	N	Mean	Std. deviation	Df	t-value	P-value	Decision
Male	25	29.36	5.582	55	3.968	0.000	Reject Ho
Female	32	22.28	7.424				

Table 4.6 shows the t-test comparison of male and female Biology teachers on ICTs competency in Teaching of Biology in public Senior Secondary Schools in Kano metropolis. The critical p-value (0.000) is less than the calculated t-value (3.968). This shows that statistically, there is significance gender difference in the competency of utilizing ICTs by male and female Biology teachers at 0.05 level of significance. Male have a mean score of 29.36 and females have a mean score of 22.28 respectively. Therefore, going by the decision rule, the null

hypothesis (H01) was rejected. Hence there existed a significant difference between Biology male teachers and Biology female teachers' competency in ICTs competence and utilization.

Research question 5: What are the challenges facing Biology teachers in accessing and using ICTs materials for Biology class instruction?

To answer this question, mean and standard deviation was used to determine the challenges Biology teachers are facing in accessing and utilizing ICTs resources in the Teaching of Biology, the reason ofusing mean and standard deviation was to find out the mean score of the major challenges Biology teachers are facing in accessing and utilizing ICTs in the Teaching of Biology on a four point likert scale. The decision rule drawn was a mean score cut off point of 2.50. Implying that all items with a mean score of 2.50 and above are considered agree and below 2.50 is considered disagree. The result is presented in table 4.7 as follows:

Table 4.7: Teachers' responses on challenges they are facing when accessing and utilizing ICTs for the Teaching of Biology

Items	Mean	Stdrd.dev.	Total	Decision
Lack of computer laborator	3.00	0.756	57	Strongly agree
Poor infrastructure	2.89	0.748	57	Agree
Lack of computer peripherals e.g. scanner, print	2.98	0.668	57	Agree
Lack of computer peripherals e.g. scanner, printe	2.04	0.785	57	Disagree
Irregular power supply	3.60	0.67	57	Strongly agree
Lack of fund	3.05	0.666	57	Strongly agree
Cost of purchasing computer	2.88	0.803	57	Agree
Competent deficiency in utilizing ICTs to teach Biolog	2.63	0.85	57	Agree
Insufficient time to make use of Computers	2.65	0.87	57	Agree
Lack of technician	2.56	0.88	57	Agree
Lack of confidence in using ICT facilities	2.53	0.928	57	Agree

Table 4.7 result on challenges facing Biology teachers in accessing and utilization of ICTs in Teaching of Biology shows that the mean score of lack of computer laboratory (3.00), irregular power supply (3.60), lack of fund (3.05) is 3.00 and above, meaning that public Senior Secondary Schools Biology teachers strongly agree that lack of computer laboratory, irregular power supply, lack of fund are the major challenges they are facing in accessing and utilizing ICT facilities. The mean score of poor infrastructures, lack of computer peripherals, cost of purchasing computers, competent deficiency in utilizing ICTs, insufficient time to make use of computers, lack of technician and lack of confidence in using ICT facilities has a mean score of 2.50 and above, meaning that public Senior Secondary Schools Biology teachers also strongly agree with such obstacles as the challenges they are facing in accessing and utilizing ICTs for Biology instruction. Only lack of cooperation by theschool principal has a mean score of below 2.50, this indicates that public Senior Secondary Schools Biology teachers disagree with lack of cooperation by the school principal is among the major challenges they are facing when accessing and utilizing ICT resources.

4.3 Summary of the Findings

The summary of the major findings of this research study are as follows:

i. For research question one from the checklist, the study revealed that ICTs resources like computers, Interactive white board, projectors, digital camera, television, etc are not available for Teaching of Biology in public Senior Secondary Schools in Kano metropolis.
ii. It is also found from the study that majority of Biology teachers in public Senior Secondary Schools in Kano metropolis do not have access to utilizing basic ICTs

facilities such as computers, smart boards, projectors, , digital camera, television, internet facilities etc when Teaching of Biology.

iii. The study shows that most of the Biology teachers in public Senior Secondary Schools in Kano metropolis are not utilizing such ICTs facilities during the course of Teaching Biology. The extent of utilization is very low.

iv. The study revealed that Biology teachers in public Senior Secondary Schools in Kano metropolis who took part in the study are competent in utilizing ICTs facilities in such areas like internet browsing, Microsoft office word and use of printer, specifically to improve and enhance effectiveness and the quality of their Teaching. And they are not competent in utilizing other ICTs like power point, excel, projectors, digital camera, scanning machine and DVD/CD ROMS which are very good in teaching all aspects of Biology.

v. The study also revealed that Biology teachers in public Senior Secondary Schools in Kano metropolis are seriously facing many challenges in accessing and utilization of ICTs resources in their Teaching. Such challenges include; Lack of computer peripherals, Poor infrastructures, lack of fund, Cost of purchasing computers, Lack of computer laboratory, competent deficiency in utilizing computers to teach Biology, Lack of technician, lack of confidence in using ICTs facilities, and Irregular power supply to support the full application of ICTs.

vi. For the null hypothesis tested, the findings of this study revealed that significant gender difference exist between male and female Biology teachers on ICTs competence and utilization in Biology content delivery in public Senior Secondary Schools in Kano metropolis.

4.4 Discussion of the Result

The result obtained from the checklist on the available ICTs resources used by Biology teachers in Biology content delivery in public Senior Secondary Schools in Kano metropolis, the findings of the study from the checklist shows that ICTs facilities are not available and are not used in public Senior Secondary Schools in Kano metropolis to teach Biology.

This might be due to the non provision of the ICT resources by the government or the policy makers. Meanwhile the significance role these ICTs are playing for a sound and effective teaching of Biology but still they are inadequate in public Senior Secondary Schools in Kano metropolis for Biology teachers to integrate them during the course of Biology instruction. This finding confirms the finding of the study conducted by Mavellas, Wellington &Samuel (2016) on Assessment of the Availability and Utilization of ICT for Teaching and Learning in Secondary Schools in Kwekwe, Zimbabwe. The finding shows that ICT resources are inadequate and the extent of utilization is low. This result is also in supports of the result of the study conducted by Amuchie (2015) on his study title Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and JalingoTaraba State. The study found that the extent of availability of ICT resources in Secondary Schools in Ardokola and Jalingo is very low. The extent of utilization of ICT resources in Teaching and learning is equally very low. ICT resources were not available in the Schools for the use of teachers and students for learning activities.

Similarly, Eze and Aja (2014) conducted a study on Availability and utilization of Information Communication Technology (ICT) in Ebonyi Local Government area of Ebonyi State. The study found that the availability of ICTs devices is not adequate and the available ICT devices are not effectively utilized. This finding comfirms the finding of Jude and Dankaro (2012) On ICT resource Utilization, Availability and Accessibility by Teacher Educators for

Instructional Development in College of Education katsina-Ala. The findings revealed that ICT resources were not available and for that reason, teacher educators could not access them for instructional purpose.This finding also supports the finding of Adeji (2011) on Availability and Use of ICT in South-Western Nigeria Colleges of Education where the finding revealed non availability of ICT equipment.This study confirms the findings of Idoko and Ademu (2010), both of them declared that ICTs availability often been found to be one of the most important barrier to technology adoption and integration in learning. They indicated that there is an urgent need for more computer literate teachers if the country is to successfully integrate ICTs in Schools. Similarly, Ajayi, Ekundayo, &Haastrup (2009) conducted a study on Application of Information Communication Technology in Nigerian Secondary Schools where the study revealed that ICT resources were lacking due to unavailability in Secondary Schools in Ondo and Ekiti state of Nigeria. Also teachers could not access ICTs resources to deliver instruction. This may be due to the non provision of the ICT resources by the school management, ministry of education/ or the Government.

With regard to the access of ICTs facilities by Biology teachers, the result shows that the mean score of all items is below 2.50. Desktop computer has a mean score of 1.98, laptop computer 2.04, Interactive white board 1.98, Projectors 2.00, Digital camera 1.40, Television 1.44, DVD player 1.72, and Internet facilities 1.81. This clearly indicates that ICTs facilities are not accessible in public Senior Secondary Schools. Biology teachers do not have access to any of these ICTs facilities to deliver Biology instruction.This finding confirmed the finding of Aramide, Ladipo and Adebayo (2015) on Demographic Variables and ICTs Access as Predictors of Information Communication Technologies' Usage among Science Teachers in Federal Unity Schools in Nigeria. The study found that the level of accessing science based ICT facilities

among Science Teachers in Federal Unity Schools in Nigeria is low.Another study that confirms the finding of this study is the study conducted by Jude and Dankaro (2012) on ICTs Resource Utilization, Availability and Accessibility by Teacher Educators for Instructional Development in College of Education katsina-Ala, Benue state. Nigeria. The study revealed that ICT resources were not accessible and for that reason, teacher educators could not access them for instructional delivery.These findings are dissimilar with the finding of Sorgo, Verckovnik and Kojiyancic (2010) on ICTs in Biology Teaching in Slovenian Secondary Schools, where the study found that all of the Biology teachers who responded to the questionnaire have access to computers for Biology instruction when needed.

On the finding of this study in respect to the level of ICTs utilization by Biology teachers in content delivery, results shows that the mean score of all items in research question 3 on the extent of ICTs utilization is below 2.50. Desktop Computer has a mean score of 2.07, Laptop Computer 2.05, 2.39, 1.86, Projectors 2.39, Interactive white board 1.86, Digital camera 1.82, Television 1.86, DVD player 1.96, and internet facilities 2.16. This means that the level of utilization of these ICTs resources by Biology teachers for the Teaching of Biology is to a low extent. This means that most Biology teachers in public Senior Secondary Schools are not utilizing ICTs facilities to teach Biology. This might be due to inadequacy of ICTs facilities, lack of access and teachers' inadequate ICTs skills. The finding of this study thus confirms the finding ofAmuchie (2015) on his study titled Availability and Utilization of ICTs Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and JalingoTaraba State. The study found that the extent of utilization of ICT resources in Teaching and learning is very low due to the non availability of ICTs resources. ICTs resources were not available in the Schools for the use by teachers and students for learning activities. Similarly, this finding supports the finding of

Eze and Aja (2014) on Availability and utilization of Information Communication Technology (ICTs) in Ebonyi Local Government area of Ebonyi state. The study found that the available ICTs devices are not effectively utilized. Ngwu (2014) conducted a study on Assessment of Availability and Utilization of ICTs Resources in Teaching in F.C.E. Eha-Amufu Enugu Nigeria. The finding of the result shows that the extent of utilization of ICTs by teachers is to a very low extent because most of ICTs are not available. This also confirms the finding of another study conducted by Jegede (2013) on Students' Perception of the Availability and Utilization of Information Communication Technology (ICT) in the Teaching and Learning of Science Subjects in Secondary Schools in Ekiti State, Nigeria. The study shows that ICT facilities are not available for science subjects' instruction in Secondary Schools, and due to that, teachers are not utilizing them.

With regard to the ICTs competence level among Biology teachers for effective Teaching ofBiology, the result shows that the mean score of internet browsing (2.77), Microsoft office word (2.56) and printer (2.63) is above 2.50, meaning that public Senior Secondary Biology teachers are competent for utilizing such items for effective Teaching of Biology.This finding confirms the finding of Singh and Chan (2014) on their study title Teacher Readiness on ICTs Integration in Teaching and Learning. The study found that the teachers' level of knowledge on ICTs is moderate as they were only good at using certain applications such as spread sheet, presentation software and e-mailing as these are the main applications which are commonly and often used in the Teaching profession.This finding supports the finding of Oyeronke (2013) on Assessment of Computer and ICTs Skills among Secondary School Teachers in Ota Ogun State. The study revealed that majority of the teachers in the Secondary Schools sample were computer and ICTs literate. Similar, this finding supports the finding of Andoh (2012) 0n Exploration of

Teachers' Skills, Perceptions and Practices of ICTs in Teaching and Learning in the Ghanaian Second-Cycle Schools. The finding of the study revealed that majority of teachers was moderately competent in word processing. This finding is also confirms by the finding of Yusuf and Balogun (2011), in their study on Student-Teachers' Competence and Attitude towards Information Communication Technology in Nigerian university found that majority of students are competent in the use of few basic ICTs tools. On the contrary, the result shows that the mean score of power point (2.26), excel (1.96), projectors (2.28), digital camera (1.95), digital microscope (2.23), scanning machine (2.19) and DVD/CD ROMS (2.21) is below 2.50, this means that public Senior Secondary Schools Biology teachers are not competence in utilizing such items for effective Teaching of Biology. This finding confirms the finding of Igomu and Solomon (2015) on Assessment of ICTs Competence among Teachers of Federal Unity Colleges in North Central Geo-political of Nigeria revealed that the competency level of FUC teachers is low and majority of FUC teachers cannot utilize ICTs in teaching their subjects. Most teachers have personal computers/laptops but have little or no competence to utilize such ICTs.This finding supports the finding of Ngwu (2014) on Assessment of Availability and Utilization of ICTs Resources in Teaching in F.C.E. Eha-Amufu Enugu Nigeria. The result revealed that teacher educators lack relevant skill for ICTs utilization that will help improve and promote Teaching-learning process.This confirms the finding of another study conducted by Badau and Sakiyo (2013) on Assessment of ICTs Teachers' Competence to Implement the New ICTs Curriculum in North Eastern Nigeria where the study found that teachers are not competent to implement new ICTs curriculum. Similarly, the finding of this study in this regard also corroborates with the findings of another study conducted by Obakhume (2010) on Assessment of Secondary school Teachers' use of Information Communication Technology (ICT) in Oyo

Metropolis, Oyo State. The study found that most of the teachers lack knowledge, competence to use ICTs to facilitate teaching learning process. This finding also support the finding of Ololube (2006) in his study on the teacher instructional materials utilization and competencies in Secondary Schools in sub-Sahara Africa, where the finding revealed that lecturers are not well competent and not trained in using ICTs in Teaching as a means for educational sustainability, and that the level of the teachers' exposure to the tool of ICTs has been very minimal.

With regard to the null hypothesis which states that there is no significant gender difference on ICTs competence among male and female Biology teachers in Biology content delivery in public Senior Secondary Schools in Kano metropolis. The t-test comparison shows thatthe critical p-value (0.000) is less than the calculated t-value of (3.968) at 0.05 level of significance. Thus, the null hypothesis was rejected and statistically there is a significant gender difference in ICTs competency among male and female Biology Teachers, with male Biology teachers are more competent in ICTs than their female counterpart. This finding confirmed the finding of Akpan (2014) on ICT Competence and Lecturers' Job Efficacy in Universities in Cross River State, Nigeria which foundthat the level of ICT competence of lecturers significantly enhanced their job efficacy. Similarly, Zubairu (2014) conducted a study on assessment of availability, accessibility and use of ICTs in content delivery among lecturers in federal colleges of education in Nigeria. The study found out that a significant difference exists between male lecturers and female lecturer's view on ICT availability and utilization. This is one special indication that opposed the finding of Omoniyi and Quadri (2013) on Perceived Competence of Nigerian Secondary Schools Teachers in the Use of Information Communication Technology (ICT).The finding shows that there was no significant difference in the ICT competence of Experienced and Less-experienced teachers.

On the finding of this study with regard to the challenges facing Biology teachers towards accessing and utilizing ICT facilities in Biology content delivery, the results indicated that irregular power supply, lack of fund, lack of computer laboratory, poor infrastructures, cost of purchasing computers etc. to support the full integration and application of ICTs are the most serious challenges being faced by Biology teachers when accessing and utilizing ICTs in Biology content delivery. The result also shows that very few respondents indicated lack of cooperation by the school principal as challenges in accessing and using of ICTs. Although, the result shows that the majority of Biology teachers in public Senior Secondary Schools are faced with serious challenges in accessing and utilization of ICTs in their Teaching. This finding supports the findings of Ihechukwu and Ndidi (2016) on impediments to integration of ICT in Teaching and learning of mathematics in Secondary Schools in Imo state. They found that the major barriers towards integration of ICT in Secondary Schools include the following: inadequate ICT facilities, lack of teachers confidence and competence, negative attitude among teachers, inadequate ICT personnel, classroom facilities, time of integration, inadequate electricity supply, poor ICT policy implementation etc. This finding is in support of the finding of Ajayi, Ekundayo and Haastrup (2009) on the application of Information and Communication Technologies in Nigerian Secondary Schools. They found that, the major challenge facing the adoption and integration of ICTs in Nigerian Secondary Schools are irregular power supply with (98.1%) respondents, lack of computer literate teachers with (89.4%) respondents, lack of fund in Schools with (84.7%) and inadequate facilities to support the integration and application of ICTs with (82.2%) respondents.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction: This chapter discussed the summary, conclusions and recommendations of the study with the following headings; summary, conclusion, contribution to knowledge, limitation of the study and recommendations

5.2 Summary

The main aim of this study is to investigate the level of Availability, Access and Use of ICT facilities in Teaching of Biologyin public Senior Secondary Schools in Kano state metropolis. The objectives of the study, research questions and research hypothesis were derived based on the major variables as outlined in chapter one of this study. This study covered sixteen (16) public Senior Secondary Schools in Kano metropolis.The Schools are; GGC Kano, GGSS Dukawuya, GSS Gwammaja, GSS S/Kofa, GGSS G/albasa, GSS K/Nassarawa, GSS Sharada, GSS Hotoro North, GSS Stadium, GSS Dakata, GSS Giginyu, GSS Maikwatashi, GSTC Kano, and Day Science College.The study was specifically targeted to determine the availability, accessibility, utilization, competence and challenges faced by Biology teachers in Biology content delivery.

Most of the related literature reviewed and empirical studies held a belief that accessibility of ICTs facilities in content delivery could be of help to teacher during the course of instruction. The study adopted survey research design. The population of the study comprises of all Biology teachers in public Senior Secondary Schools in Kano metropolis. The teachers are two hundred and eighteen (218) in number. Sample sizes of fifty eight (58) Biology teachers were used for the study. The instrument for data collection was a checklist and modified questionnaire. Fifty eight (58) questionnaires were distributed to the respondent but only fifty seven (57) questionnaires were returned. The content validity of the instrument was ascertained

by giving the questionnaire to assess by two Senior Lecturers with a rank of Ph.D from Science and Technology Education Department, Bayero University Kano and one Assistant Professor from Applied Biology Department of the same university. Thirty (30) copies of the questionnaires were pilot tested in public Senior Secondary Schools that are out of the population. The reliability co-efficient of 0.89 was obtained at 0.05 level of significance.

Frequency and percentages were used to interpret the demographic data of the respondents of the study and also the checklist, descriptive statistics using mean and standard deviation was used to answer research questions 2-5 respectively. The independent t-test was also used to analyze research hypothesis and was tested at 0.05 level of significance using Statistical Package for Social Science (SPSS).

5.3 Conclusion

In view of the findings obtained from this study, it was concluded that

1. A greater number of ICTs Facilities required for Biology instruction by Biology teachers were not available in public Senior Secondary Schools in Kano metropolis. This could be due to the non provision of ICT facilities by the school management or the government.
2. This study also found that Biology teachers have no access to basic ICT tools required to deliver Biology instruction. This may be due to inadequacy of electricity supply or poor infrastructures.
3. It was also concluded from the study that Biology teachers in public Senior Secondary Schools are not utilizing ICT facilities and have low competency to apply basic ICT facilities in Biology content delivery. This may be due to teachers' inadequate ICT

knowledge and skills. They are only competent in utilizing some of the ICT facilities like internet browsing, Microsoft office word and use of printer.

4. This study concludes that a significant difference exists between male teachers and female Biology teachers in the level of ICTs competency for effective Teaching of Biology. Male Biology teachers are more competent in utilizing ICTs than female Biology teachers.
5. It was also concluded from the study that the challenges facing Biology teachers when accessing and using of ICTs in public Senior Secondary Schools in Kano state metropolis are irregular power supply, lack of fund, lack of laboratory among others.

Conclusively, the findings and the conclusion of this study can therefore, said to have answered both research questions and research hypothesis.

5.4 Contribution to knowledge

The contributions to knowledge of this study are as follows:

1. This study established that non availability of ICTs facilities existed in public senior secondary schools in Kano metropolis and this made it difficult for Biology teachers to integrate such essential ICTs required for Biology class instruction.
2. It has been established that due to the non availability of ICTs, Biology teachers do not have access to integrate and utilize the basic ICTs required for Biology content delivery.
3. The study also established that Biology teachers exhibit some level of competency in some of the basic ICTs required for Biology teaching.

5.5 Limitation of the study

This study has limited itself only to public Senior Secondary Schools in Kano state metropolis. It covered four local government areas out of eight local government areas with a total population of 218 Biology teachers out of which only 58 were the participants. The selection of the sample

was to make easy generalization. Secondly, the study was centered on ICTs availability, accessibility, utilization, competence and challenges faced by Biology teachers in accessing and utilizing of ICTs.

Another limitation is that the finding obtained from the checklist which answer research question one on ICTs availability shows non availability of ICTs facilities and the finding obtained from the questionnaire which answer research question three on the extent of ICTs utilization shows low extent of utilization. This was due to the decision rule made in the questionnaire and the way the respondent respond to the question. But initially ICTs facilities are not available and Biology teachers are not utilizing them to teach Biology.

5.6 Recommendations

5.6.1 Recommendation from the study

1. There is a need for Kano state Government and policy makers to respond positively towards provision of adequate ICT infrastructures in all the public Senior Secondary Schools across the state. This is to encourage and motivate teachers to utilize them during Teaching and learning. Since finding of this study shows ICTs competency by Biology teachers in such areas like internet browsing, Microsoft office word, use of projector etc.
2. Policy makers should introduce and implement oriented policies that will support ICT related Teaching methods in order to encourage both students and teachers to utilized ICT in Teaching and learning activities.
3. There should be teacher training programmes like workshop and skill development of teachers that will encourage them to have the requisite skill, competence and exposure to ICTs that will enable them to be more proficient in the utilization of ICTs in instruction. The school management and other stakeholders can do this in partnership with other organizations to provide training or workshop on such ICTs periodically. It is also

recommended that Kano state government should ensure to provide female teachers with ICT knowledge and skills that can enable them to teach and compete successfully in the state and even the global Information economy and play a leadership role towards its progress.

4. It is recommended that school management, teachers, community members and other stake holders should join hands together and ensure that computer laboratories are provided with adequate functional computer hardware and software. There should also be regular power supply so as to enhance adequate utilization of ICTs and also make the use of ICT practiceable in public Senior Secondary Schools. There should be a functional internet that will cater for the need of both teachers and students. The government should increase funding for the educational sector of the state with emphasis on ICT that will help improve the level of ICT facilities in the Schools.

5.6.2 Suggestion for further Studies

1. A Comparative Analysis of Availability, Accessibility and Utilization of ICTs in Teaching of Biology in Public and Private Senior Secondary Schools in Kano State.

2. Effects of Information and Communication Technologies on Biology Students Academic Achievements in Public Senior Secondary Schools in Kano State.

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APPENDIX I
BAYERO UNIVERSITY KANO
SCHOOL OF POSTGRADUATE STUDIES
DEPARTMENT OF SCIENCE AND TECHNOLOGY EUCATION
ICTs AND SENIOR SECONDARY SCHOOLS BIOLOGY TEACHERS QUESTIONNAIRE (ICTSSSBTQ)

AVAILABILITY, ACCESS AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN THE TEACHING OF BIOLOGY IN PUBLIC SENIOR SECONDARY SCHOOLS IN KANO STATE METROPOLIS

Dear Respondent

I am a student of Science and Technology Education Department, Bayero University Kano. Conducting a research on "Availability, Access and use of Information and Communication Technologies in the Teaching of Biology in Public Senior Secondary Schools in Kano state metropolis" which is part of the partial fulfillment for the award of Master Of Science Education M.Sc. Ed (Biology) degree.

The study is purely for academic exercise; as such your confidentiality will be highly assured.

Please feel free to respond to the question appropriately. Thank you.

Instruction: The questionnaire has been designed under five (5) different section with all the Items harmonized in one single questionnaire; please endeavor to respond to all items by a tick (√) against the appropriate option that reflect or show your personal opinion to the item. Section A requires your demographic data, while sections B-E is on "Access and Use of ICTs in the Teaching of Biology in Public Senior Secondary Schools in Kano metropolis".

Section A

Demographic Data

Sex: Male [ ] Female [ ]

Section B

ICT facilities Accessible to teachers whenever intended for Biology instruction

Please indicate from these options. Highly Accessible (4), Accessible (3), Fairly Accessible (2) Not Accessible (1)

Q. 2. Which types of ICT facilities are accessible to you in Teaching of Biology?

S/N	Items	Highly accessible	Accessible	Fairly accessible	Not accessible
1	Desktop computer				
2	Laptop computer				
3	Interactive white board				
4	Projectors				
5	Digital microscope				
6	Digital camera				
7	Television				
8	DVD player				
9	Internet facilities				

Section C

Extent of ICTs utilization by Biology Teachers

Please indicate from these options. Very High Extent (4), High Extent (3), Low Extent (2), Very Low Extent (1)

Q.3. what is your level of utilizing ICT resources for Biology instruction?

S/N	Items	Very high extent	high extent	low extent	very low extent
10	Desktop Computer				
11	Laptop Computer				
12	Interactive white board				
13	Projectors				
14	Digital microscope				
15	Digital camera				
16	Television				
17	DVD player				
18	Internet facilities				

Section D

Competence of utilizing ICTs by Biology teachers

Please indicate from these options. Highly Competent (4), Competent (3), Moderately Competent (2), Low Competent (1)

Q.4. what is your competence level of using these ICT facilities for Teaching of Biology?

S/N	Items	Highly competent	competent	moderately competent	low competent
19	Internet browsing				
20	Power point				
21	Microsoft office word				
22	Excel				
23	Projectors				
24	Digital camera				
25	Digital microscope				
26	Scanning machine				
27	Printer				
28	DVD/CD ROMS				

SECTION E

Challenges facing Biology teachers in accessing and utilization of ICT facilities

Please indicate from these options. Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree

Q.5. what challenges are you confronting when accessing and utilization of ICTs when Biology instruction?

S/N	Items	Strongly agree	Agree	Disagree	Strongly disagree
29	Lack of computer laboratory				
30	Poor infrastructures				
31	Lack of computer peripherals e.g. scanner, printer				
32	Lack of cooperation by the school principal				
33	Irregular power supply				
34	Lack of fund				
35	Cost of purchasing computers				
36	Competent deficiency in utilizing ICTs to teach Biology				
37	Insufficient time to make use of computers				
38	Lack of technician				
39	lack of confidence in using ICT facilities				

THANK YOU FOR COMPLETING THE QUESTIONNAIRE

APPENDIX II

SPSS OUTPUT OF THE CHECKLIST OF DETERMINING AVAILABILITY OF ICTs FOR TEACHING OF BIOLOGY IN PUBLIC SENIOR SECONDARY SCHOOLS IN KANO METROPOLIS

Research Question 1

S/N	items	available		Not available		Total frequency	Total percentage
		F	%	F	%		
1	Desktop computer	1	6.3	15	93.8	16	100%
2	Laptop computer	2	12.5	14	87.5	16	100%
3	Interactive white board	0	0	16	100	16	100%
4	Projectors	6	37.5	10	62.5	16	100%
5	Digital Microscope	1	6.3	15	93.8	16	100%
6	Digital camera	1	6.3	15	93.8	16	100%
7	Television	0	0	16	100	16	100%
8	DVD player	0	0	16	100	16	100%
9	Internet facilities	0	0	16	100	16	100%

APPENDIX III

SPSS OUTPUT OF THE RESEARCH INSTRUMENT

Gender of the Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25	43.9	43.9	43.9
Male	32	56.1	56.1	100.0
Female	57	100.0	100.0	
Total				

Research Question 2

Descriptive Statistics

	N	Mean	Std. Deviation
Desktop computer	57	1.96	.801
Laptop computer	57	2.04	.823
Interactive white board	57	1.98	.916
Projector	57	2.00	1.035
Digital Microscope	57	1.63	.698
Digital Camera	57	1.40	.776
Television	57	1.44	.802
DVD player	57	1.72	.861
Internet facilities	57	1.81	.718
Valid N (listwise)	57		

Research Question 3

Descriptive Statistics

	N	Mean	Std. Deviation
Desktop computer	57	2.07	.821
Laptop computer	57	2.05	.895
Interactive white board	57	1.86	.718
Projectors	57	2.39	1.031
Digital Microscope	57	1.79	.725
Digital Camera	57	1.82	.735
Television	57	1.86	.953
DVD Player	57	1.96	.778
Internet facilities	57	2.16	.882
Valid N (listwise)	57		

Research Question 4

Descriptive Statistics

	N	Mean	Std. Deviation
Internet Browsing	57	2.77	.866
Power point	57	2.26	.897
Microsoft office word	57	2.56	.866
Excel	57	1.96	.801
Projector	57	2.28	.861
Digital camera	57	1.95	.811
Digital microscope	57	2.23	.926
Scanning Machine	57	2.19	.934
Printer	57	2.63	.993
DVD/CD ROMS	57	2.21	.901
Valid N (listwise)	57		

Research Question 5

Descriptive Statistics

	N	Mean	Std. Deviation
Lack of computer laboratory	57	3.00	.756
Poor Infrastructures	57	2.89	.748
Lack of computer peripherals e.g scanner, printer	57	2.98	.668
Lack of cooperation by the school principal	56	2.04	.785
Irregular power supply	57	3.60	.678
Lack of fund	57	3.05	.666
Cost of purchasing computer	57	2.88	.803
Competent deficiency in utilizing computers to teach Biology	57	2.63	.858
Insufficient time to make use of computer	57	2.65	.876
Lack of technician	57	2.56	.887
Lack of confidence in using ICT facilities	57	2.53	.928
Valid N (listwise)	56		

Hypothesis 1

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
ICTs Competence	Male	25	29.36	5.582	1.116
	Female	32	22.28	7.424	1.312

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ICTs Competence	Equal variances assumed	3.714	.059	3.968	55	.000	7.079	1.784	3.504	10.654
	Equal variances not assumed			4.109	54.939	.000	7.079	1.723	3.626	10.532

APPENDIX IV

SPSS OUTPUT OF RELIABILITY OF THE INSTRUMENT USING PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT

Correlations

		First test	Second test
First test	Pearson Correlation	1	.891*
	Sig. (2-tailed)		.028
	N	15	15
Second Test	Pearson Correlation	.891*	1
	Sig. (2-tailed)	.028	
	N	15	15

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX V

EDUCATIONAL AND PSYCHOLOGICAL MEASUREMENT
1970, 30, 607-610.

DETERMINING SAMPLE SIZE FOR RESEARCH ACTIVITIES

ROBERT V. KREJCIE
University of Minnesota, Duluth

DARYLE W. MORGAN
Texas A. & M. University

The ever increasing demand for research has created a need for an efficient method of determining the sample size needed to be representative of a given population. In the article "Small Sample Techniques," the research division of the National Education Association has published a formula for determining sample size. Regrettably a table has not bee available for ready, easy reference which could have been constructed using the following formula.

$$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P).$$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

1.96 x 1.96 = 3.8416

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

No calculations are needed to use Table 1. For example, one may wish to know the sample size required to be representative of the opinions of 9000 high school teachers relative to merit pay increases. To obtain the required sample size enter Table 1 at N = 9000. The sample size representative of the teachers in this example is 368. Table 1 is applicable to any defined population.

The relationship between sample size and total population is illustrated in Figure 1. It should be noted that as the population increases the sample size increases at a diminishing rate and remains relatively constant at slightly more than 380 cases.

REFERENCE

Small-Sample Techniques. *The NEA Research Bulletin*, Vol. 38 (December, 1960), p. 99.

TABLE 1

Table for Determining Sample Size from a Given Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

APPENDIX VI

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD

DEPARTMENT OF PLANNING, RESEARCH AND STATISTIC

LIST OF SCHOOLS, TEACHERS AND STUDENT ENROLMENT IN KANO METROPOLITANT ZONE AS AT JANUARY 2015

S/N	ZONE	LGA	SCHOOL NAME	TOTAL ENROLMENT	NO. TEACHERS
1	DALA	DALA	GASS YALWA	756	23
2	DALA	DALA	GGASS GWAMMAJA	1140	34
3	DALA	DALA	GGC DALA	1910	61
4	DALA	DALA	GGSS BULUKIYA	1878	37
5	DALA	DALA	GGSS DANDINSHE	1212	14
6	DALA	DALA	GGSS GORON DUTSE	866	0
7	DALA	DALA	GGSS GWAMMAJA	792	19
8	DALA	DALA	GGSS KOFAR MAZUGAL	1430	32
9	DALA	DALA	GGSS KURNA	840	0
10	DALA	DALA	GGSS YAMMATA	1644	14
11	DALA	DALA	GSS ABDU NALITI	875	3
12	DALA	DALA	GSS DALA	3768	43
13	DALA	DALA	GSS GWAMMAJA	2965	43
14	DALA	DALA	GSS KOFAR DAWANAU	1015	14
15	DALA	DALA	GSS KOFAR RUWA	943	9
16	DALA	DALA	GSS KURNAR ASABE	1354	27
17	NASSARAWA	FAGGE	ABDULLAHI SANI M/L CQS	188	1
18	NASSARAWA	FAGGE	ADSS BUKAVU BOYS	3770	39
19	NASSARAWA	FAGGE	ADSS BUKAVU GIRLS	2509	29
20	NASSARAWA	FAGGE	GC KANO	2765	60
21	NASSARAWA	FAGGE	GGASS M. FAGGE	775	20
22	NASSARAWA	FAGGE	GGASS TUDUN BOJUWA	3222	53
23	NASSARAWA	FAGGE	GGSS AISHA SHEHU	810	9
24	NASSARAWA	FAGGE	GGSS DAN RIMI	1270	9
25	NASSARAWA	FAGGE	GGSS MAIKWATASHI	2700	50
26	NASSARAWA	FAGGE	GGSS MARYAM ABACHA	1345	29
27	NASSARAWA	FAGGE	GSS DARERAWA	1540	13
28	NASSARAWA	FAGGE	GSS GOGAU	795	13
29	NASSARAWA	FAGGE	GSS KAWAJI	3000	48
30	NASSARAWA	FAGGE	GSS KWAKWACHI	1869	35
31	NASSARAWA	FAGGE	GSS MAIKWATASHI	2146	31
32	NASSARAWA	FAGGE	GSS MVA KUKA	3100	51
33	NASSARAWA	FAGGE	GSS TUDUN BOJUWA	1192	2

34	DALA	GWALE	CEC G/GALADIMA	652	27
35	DALA	GWALE	GAC GWALE	2648	53
36	DALA	GWALE	GGAC GORON DUTSE	2658	57
37	DALA	GWALE	GGASS B/SABON SARA	720	26
38	DALA	GWALE	GGASS KOFAR NA'ISA	1564	40
39	DALA	GWALE	GGC KANO	2386	56
40	DALA	GWALE	GGSS AISAMI	699	23
41	DALA	GWALE	GGSS DORAYI BABBA	1151	19
42	DALA	GWALE	GGSS DUKA WUYA	1396	25
43	DALA	GWALE	GGSS GWALE	1303	14
44	DALA	GWALE	GGSS JA'EN	1025	18
45	DALA	GWALE	GGSS JAMBULO	1063	15
46	DALA	GWALE	GGSS SANI MAINAGGE	1692	51
47	DALA	GWALE	GGSS UNGUWAR DABAI	751	3
48	DALA	GWALE	GSS DORAYI BABBA	1520	31
49	DALA	GWALE	GSS DORAYI KARAMA	1255	14
50	DALA	GWALE	GSS GORON DUTSE	2656	63
51	DALA	GWALE	GSS GWALE	2885	58
52	DALA	GWALE	GSS WARURE	2520	55
53	D/KUDU	KUMBOTSO	GGASS PANSHEKARA	1404	0
54	D/KUDU	KUMBOTSO	GGASS SHEKA	2171	36
55	D/KUDU	KUMBOTSO	GGSS ABDU MARIRI	1113	28
56	D/KUDU	KUMBOTSO	GGSS CHALAWA	372	8
57	D/KUDU	KUMBOTSO	GGSS CHIRANCHI	2156	0
58	D/KUDU	KUMBOTSO	GGSS GURUNGAWA	548	0
59	D/KUDU	KUMBOTSO	GGSS KUMBOTSO	518	9
60	D/KUDU	KUMBOTSO	GGSS MEDILE	972	0
61	D/KUDU	KUMBOTSO	GGSS WAILARI	1270	34
62	D/KUDU	KUMBOTSO	GGSS ZAWACHIKI	719	0
63	D/KUDU	KUMBOTSO	GOVT. COLLEGE ZAWACHIKI	480	4
64	D/KUDU	KUMBOTSO	GSS CHALAWA	277	8
65	D/KUDU	KUMBOTSO	GSS D/MALIKI	986	0
66	D/KUDU	KUMBOTSO	GSS DANBARE	573	18
67	D/KUDU	KUMBOTSO	GSS DANLADI NASIDI	0	14
68	D/KUDU	KUMBOTSO	GSS G/DAU	406	0
69	D/KUDU	KUMBOTSO	GSS JA'O'JI	960	26
70	D/KUDU	KUMBOTSO	GSS KAYI P.	1081	15
71	D/KUDU	KUMBOTSO	GSS KUMBOTSO	1109	0
72	D/KUDU	KUMBOTSO	GSS MARIRI	1510	32

73	D/KUDU	KUMBOTSO	GSS NA'IBAWA	2179	39
74	D/KUDU	KUMBOTSO	GSS PANSHEKARA	1943	55
75	D/KUDU	KUMBOTSO	GSS SHEKA	2585	48
76	D/KUDU	KUMBOTSO	GSS U/RIMI	585	5
77	D/KUDU	KUMBOTSO	SES TUDUN MALIKI	0	48
78	D/KUDU	KUMBOTSO	SRCOE STAFF SCHOOL	0	0
79	MUNICIPAL	MUNICIPAL	ABC CPS KANO	1172	32
80	MUNICIPAL	MUNICIPAL	CITY WOMEN CENTRE	1043	17
81	MUNICIPAL	MUNICIPAL	ENG. BASHIR KARAYE	644	14
82	MUNICIPAL	MUNICIPAL	GGASS ADO NAMAITUWO	1389	21
83	MUNICIPAL	MUNICIPAL	GGASS HASIYA BAYERO	1218	34
84	MUNICIPAL	MUNICIPAL	GGASS KOKI	462	30
85	MUNICIPAL	MUNICIPAL	GGSS FESTIVAL	1102	21
86	MUNICIPAL	MUNICIPAL	GGSS G/ALBASA	2187	54
87	MUNICIPAL	MUNICIPAL	GGSS HASSANA SUFI	2059	58
88	MUNICIPAL	MUNICIPAL	GGSS K/KUDU	638	15
89	MUNICIPAL	MUNICIPAL	GGSS MARYAM SHEKARAU	539	19
90	MUNICIPAL	MUNICIPAL	GGSS SHARADA	1835	43
91	MUNICIPAL	MUNICIPAL	GGSS SHEKARA	1576	56
92	MUNICIPAL	MUNICIPAL	GGSS YAKASAI	1135	36
93	MUNICIPAL	MUNICIPAL	GSS G/ALBASA	1503	25
94	MUNICIPAL	MUNICIPAL	GSS K/NASSARAWA	1715	71
95	MUNICIPAL	MUNICIPAL	GSS KOKI	1020	15
96	MUNICIPAL	MUNICIPAL	GSS S/KOFA	4523	76
97	MUNICIPAL	MUNICIPAL	GSS SHARADA	3615	75
98	MUNICIPAL	MUNICIPAL	HIS SHAHUCHI	1671	56
99	MUNICIPAL	MUNICIPAL	RUMFA COLLEGE	2295	68
100	MUNICIPAL	MUNICIPAL	SAS KANO	2785	76
101	MUNICIPAL	MUNICIPAL	GGASS ZOO ROAD	0	27
102	MUNICIPAL	MUNICIPAL	GGSS UMMA ZARIA	1260	36
103	NASSARAWA	NASSARAWA	GASS GIGINYU	1094	18
104	NASSARAWA	NASSARAWA	GASS KWACHIRI	1895	34
105	NASSARAWA	NASSARAWA	GGASS GAMA	2030	29
106	NASSARAWA	NASSARAWA	GGASS HOTORO (N)	680	23
107	NASSARAWA	NASSARAWA	GGASS KAWAJI	3215	52
108	NASSARAWA	NASSARAWA	GGASS TUDUN MURTALA	1362	28
109	NASSARAWA	NASSARAWA	GGASS YANKABA	1414	31
110	NASSARAWA	NASSARAWA	GGSIS GWAGWARWA	1096	21
111	NASSARAWA	NASSARAWA	GGSS DABO	2040	22

112	NASSARAWA	NASSARAWA	GGSS DAKATA	2418	31
113	NASSARAWA	NASSARAWA	GGSS DANGANA	2810	51
114	NASSARAWA	NASSARAWA	GGSS GIGINYU	2888	46
115	NASSARAWA	NASSARAWA	GGSS HOTORO (S)	1740	36
116	NASSARAWA	NASSARAWA	GGSS MAGWAN	976	38
117	NASSARAWA	NASSARAWA	GSCS AIRPORT ROAD	3000	49
118	NASSARAWA	NASSARAWA	GSS HOTORO (N)	3212	50
119	NASSARAWA	NASSARAWA	GSS KAURA GOJE	711	10
120	NASSARAWA	NASSARAWA	GSS MAGWAN	540	12
121	NASSARAWA	NASSARAWA	GSS STADIUM	2462	47
122	NASSARAWA	NASSARAWA	GSS SUNTULMA	2073	15
123	NASSARAWA	NASSARAWA	GSS TARAUNI	4740	83
124	NASSARAWA	NASSARAWA	SIS DAKATA	1596	20
125	MUNICIPAL	TARAUNI	GASS BABAN GIJI	882	22
126	MUNICIPAL	TARAUNI	GASS HAUSAWA B/R	917	16
127	MUNICIPAL	TARAUNI	GASS KUNDILA	240	10
128	MUNICIPAL	TARAUNI	GGASS H/DELU	511	20
129	MUNICIPAL	TARAUNI	GGASS SAUDAT	837	14
130	MUNICIPAL	TARAUNI	GGASS T/KUDU	874	24
131	MUNICIPAL	TARAUNI	GGASS TAHIR	1115	18
132	MUNICIPAL	TARAUNI	GGSS DARMANAWA	1353	26
133	MUNICIPAL	TARAUNI	GGSS FATIMA MUHAMMAD	1544	41
134	MUNICIPAL	TARAUNI	GGSS HAUSAWA	821	24
135	MUNICIPAL	TARAUNI	GGSS U/UKU	2111	38
136	MUNICIPAL	TARAUNI	GSS DARMANAWA	740	16
137	MUNICIPAL	TARAUNI	GSS GYADI-GYADI	1710	20
138	MUNICIPAL	TARAUNI	GSS HAUSAWA MODEL	771	17
139	MUNICIPAL	TARAUNI	GSS KUNDILA	2105	47
140	MUNICIPAL	TARAUNI	GSS U/GANO	1059	15
141	MUNICIPAL	TARAUNI	GSS U/UKU	1654	29
142	MINJIBIR	UNGOGO	GGASS UNGOGO	605	7
143	MINJIBIR	UNGOGO	GGSS GAYAWA	795	5
144	MINJIBIR	UNGOGO	GGSS JANBAKI	600	17
145	MINJIBIR	UNGOGO	GGSS KADAWA	2555	39
146	MINJIBIR	UNGOGO	GGSS RANGAZA	1155	11
147	MINJIBIR	UNGOGO	GSS BACHIRAWA	2955	28
148	MINJIBIR	UNGOGO	GSS DAN KUNKURU	784	19
149	MINJIBIR	UNGOGO	GSS JAJIRA	658	11

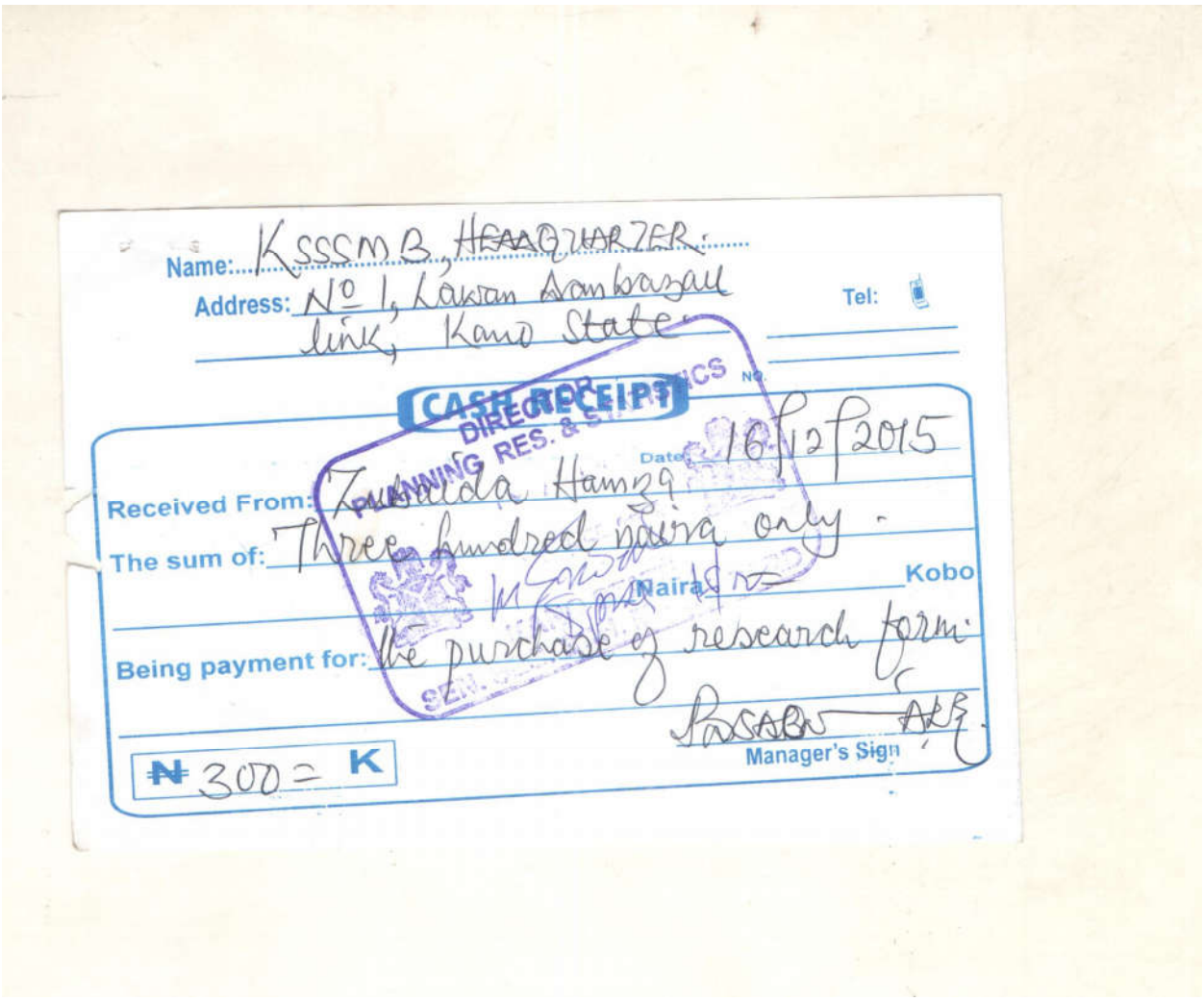
150	MINJIBIR	UNGOGO	GSS KADAWA	900	8
151	MINJIBIR	UNGOGO	GSS PANISAU	736	10
152	MINJIBIR	UNGOGO	GSS RIJIYAR ZAKI	1432	30
153	MINJIBIR	UNGOGO	GSS RIMIN GATA	1432	25
154	MINJIBIR	UNGOGO	GSS S/DOKA	549	6
155	MINJIBIR	UNGOGO	GSS UNGOGO	1320	16
156	MINJIBIR	UNGOGO	GSS Z/GABAS	1237	17
157	MINJIBIR	UNGOGO	GSS ZAURA BABBA	1495	16

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD

DEPARTMENT OF PLANNING, RESEARCH AND STATISTIC

NUMBERS OF BIOLOGY TEACHERS IN KANO METROPOLITAN AS AT JANUARY 2015

NASSARAWA/FAGGE	MUNICIPAL/TARAUNI	DALA/GWALE	KUMBOTSO	UNGOGO	TOTAL
44	62	63	18	7	194



Name: KSSSMB, HEADQUARTER.

Address: No 1, Lawan Dambazau link, Kano State.

Tel:

CASH RECEIPTS

No.

Date: 16/12/2015

Received From: Zubaida Hamza

The sum of: Three hundred naira only.

Naira ₦ Kobo

Being payment for: the purchase of research form.

₦ 300 = K

Manager's Sign

DIRECTORATE OF PLANNING RES. & STATISTICS

DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION
Faculty of Education, BAYERO UNIVERSITY, KANO

VICE-CHANCELLOR: *Professor Abubakar Rasheed mni*, B.A., M.A.(BUK), M.A.(Nottingham); PhD.(ABU) | PMB 3011, Kano, NIGERIA
Secretary: ☎+234(080)

Head: *Dr. Garba Shu'aibu, NCE, B.Sc. Ed. (Math, BUK), Med (BUK) Ph.D. (BUK)*

STE/A/SP/I Date: 30/11/2015

To whom it may concern.
TITE ESU SEC
KSSSMB

KANO STATE SNR. SEC. MANAGEMENT BOARD
RECEIVED
10-12-15

Dear Sir/Madam,

STUDENTS' RESEARCH ENQUIRIES

The bearer of this letter ZUBAIDA HAMZA MUHAMMAD with Registration Number SPS/13/MST/00008 is a Postgraduate Student of the above mentioned department currently conducting a research tilled: AVAILABILITY, ACCESS, AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN THE TEACHING OF BIOLOGY IN SENIOR SECONDARY SCHOOL IN KANO.

Please render ~~him~~/her all the necessary assistance he/she may require. All information will be treated confidentially and used only for academic purposes.

Thank you.

Yours Faithfully,

Prof. Muhammadu Abdullahi
SUPERVISOR