ASSESSING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) COMPETENCY AMONG BIOLOGY STUDENTS IN THE FEDERAL COLLEGES OF EDUCATION IN KANO STATE

BY

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SPS/14/MST/00002

JANUARY, 2017

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BEING A DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES, THROUGH THE DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION, FACULTY OF EDUCATION BAYERO UNIVERSITY KANO IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTERS DEGREE IN SCIENCE EDUCATION

(M. Sc. Ed) BIOLOGY

JANUARY, 2017

DECLARATION

"I hereby declare that this work is the product of my research efforts undertaking under the supervision of Professor MuhammaduAbdullahi, and has not been presented anywhere for the award of a degree or certificate. All sources have been duly acknowledged".

……..... ……

Peace ChijinkemNwanegbo **Date**

CERTIFICATION

This is to certify that the research work for this thesis titled “Assessing Information and Communication Technology (ICT) Competency among Biology Students in Federal Colleges of Education in Kano State” and the subsequent write-ups in the thesis by “Peace ChijinkemNwanegbo, SPS/14/MST/0002” were carried out under my supervision

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LIST OF ABBREVIATIONS

ACARA	Australian Curriculum Assessment and Reporting Authority
ANOVA	Analysis of Variance
CANs	Campus Area Networks
CD	Compact Disc
CV	Curriculum Vitae
CO2	Carbon (IV) Oxide
DBM	Database Management
DVD	Digital Video Disc or Digital Versatile Disc
FAX	Fascimile
FCE	Federal College of Education
HANs	Home Area Networks
ICT	Information and Communication Technology
IWB	Interactive White Board
JAMB	Joint Admissions and Matriculation Board
LANs	Local Area Networks
MANs	Metropolitan Area Networks
NCE	National Certificate of Education
NCTE	National Council for Teacher Education
NEEDS	National Economic Empowerment and Development Strategies
SPSS	Statistical Package for Social Sciences
TCP/IP	Transmission Control Protocol/Internet Protocol
UNESCO	United Nations Education, Scientific and Cultural Organization
WANs	Wide Area Networks

ABSTRACT

This study assessed ICT Competency among Biology Students in the Federal Colleges of Education in Kano State. It also examined the influence of gender and level in relation to ICT competency. The study used a descriptive survey research and the population comprised all the biology students of both Colleges.A population of two thousand four hundred and three (2403) biology students were the target. A sample of three hundred and thirty one biology students (331)) were randomly drawn from the population using Kraijcie and Morgan table for determining sample size (1970). The two instruments used for data collection were Check list and a questionnaire named ICT Competency Questionnaire (ICTCQ). Three (3) research questions, three (3) objectives and three (3) hypotheses were generated and formulated to guide the investigation. Data collected were analyzed using Percentage, Mean, Chi-square and ANOVA. The study shows that there are ICT resources available for use in both Federal Colleges of Education in Kano, the biology students of both Federal Colleges of Education frequently use most of the ICT facilities available but rarely use some of the resources such as power point packages, online video streaming, E-conference and posting of CV on Job websites. The hypotheses also shows that there is no significant gender difference among the Biology students of both FCE Kano and FCE (T) Bichi in their ICT competency level, but there is significant difference between NCEI, NCEII and NCEIII in their level of ICT competency.Based on the outcome of this study, the following recommendations were made among others: students should be given ICT based tasks that will enable them utilize all ICT facilities and packages to enable students have a higher degree of competency in ICT, government should also provide more ICT facilities to Colleges of Education for maximum integration of ICT in the Colleges, curriculum planners and educational stakeholders should design programs and policies that will incorporate the maximum use of ICT in teaching and learning of biology in Federal Colleges of Education.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Information and Communication Technology (ICT) is very essential for technological development in our contemporary world. ICT is seen as encompassing all gadgets and tools (including traditional technologies of radio, video and television to the newer technologies of computers, hardware, firmware, etc.), as well as methods, practices, processes, procedures, concepts, and principles that play a role in the conduct of the information and communication activities. (Federal Ministry of Education, Nigeria, 2010). Acara (2010) also noted that ICT covers a wide range of digital-related hardware and software used to support the capture, storage, transmission and retrieval of data. Apart from computers, this can include peripheral devices such as scanners, printers and speakers; mobile devices such as mobile phones; and hand held devices such as digital cameras, digital media players, calculators and data probes.

ICT Competency in the context of this study describes the required skills needed by students in carrying out ICT based task. The ability of students to effectively carry out diverse tasks in ICT shows a positive inclination to it. It is paramount that students be well equipped in the knowledge of ICT, especially, would-be-teachers in the Colleges of Education and other institutions who stand a chance of inculcating these skills and competencies to students they will be teaching in future. It will also bring about the ability to fit properly into the ever improving world of technological advancement.

The importance of integration of ICT into the educational system cannot be overemphasized. It is outrageous that despite the cognizance attributed to the knowledge of ICT as a necessary parameter for technological development, the issue of incompetence still emanate. It is paramount that students should have the basic knowledge of ICT in order to be carried along in the world's new trend of technology. It is essential that students be empowered with the ability to manipulate both hardware and software in order to adapt to the ever changing world of technology. (Danner and Pessu, 2013).

The application of ICT in education has made information retrieval fast and convenient for users and also enhances learning at one's pace. It has reduced the stress of moving from one library to another in search of information.

Bitok (2012) also points that the internet has provided a high degree of information that was not available in the past. Hanafi and Soeharto (2010) also noted that the internet, which is a large collection of computers in networks worldwide plays a vital role in the application of ICT.

The use of ICT in the teaching and learning process of Biology is very essential as it makes the teaching and learning effective, interesting, interactive and concrete thereby bringing about improved academic performance among students. It is of utmost importance that ICT be used in the teaching of Biology as this will bring abstract objects and concepts to reality, making it concrete enough for student's comprehension. Mamodou and Ngamo, (2010) observed that students get bored when certain biological concepts like digestion, transport system, cell division etc. are being taught. Since they cannot see when these processes are going on in the body, they

may not comprehend fully how these processes takes place. Through the use of ICT in teaching biological concepts, various diagrams, illustrations and PowerPoint presentations on various topics has made the teaching and learning of biology interesting and easy to comprehend, the outcome of which leads to better academic performance in biology as students are motivated to learn when their sense of sight and sound are captured. This is supported by a study carried out by Chukwudi, Izang and Olufunbi (2015) which showed that the use of ICT improves students' performance. Biology teaching is believed to take place in one or more of three different kinds of environments; the classroom, the laboratory and the field (outdoors).

"However, with the new access to multimedia technologies the experiments are being done to translate features of each of these three learning environments to the biology students' computer desktop."(Kubiatko, Yilmaz&Halakova, 2012).

Etiubon (2013) pointed out that students must acquire skills and competencies required for the use of technologies as this will enable them compete in a digitized and networked society. The world is rapidly going global technologically, therefore these skills and competencies acquired by students can help them both within the school environment and even after graduation from school, i.e. in their different workplaces. The skills and knowledge developed by students through the use of ICT can also be transferred from one ICT environment to another (such as from school to workplace and to other areas. Acara, (2010).Adeoye,Folani and Houston (2010) were also of the view that ICT skills and competencies possessed by students can give them advantages over others both within the school

environment and outside as it gives such individual better chances of employment

To increase their ICT competency level, students should be able to carry out various ICT based activities such as; using word processor to create documents, using PowerPoint packages to create slides for presentations, using graphic software such as photo-shop and Corel draw, using data-based processing software (spread sheet) such as MS Excel, using storage devices such as flash, CD, DVD, for data storage, using statistical packages(SPSS) for data processing, using the internet in carrying out researches, sending and receiving mails, online video streaming, E-conference, downloading and uploading data, photos and/or information to the internet, using social networks for students/academics,browsing sites such as the college websites, installing software on computer, registering and participating in online training programmes, posting CV on job websites, etc. The ability of students to carry out most of these activities is a limelight to competence. When students are often exposed to and manipulate ICT resources such as computers, smartphones, modem, projectors, e-boards, internet connection, and many more ICT facilities, they consciously or unconsciously attain a height of competence in the use of these resources, which enable them perform better in biology and other sciences and also equip them to integrate fully into the continuously improving world of technology

The quality time spent in using ICT resources shows a positive attitude and have great impact on learning, but when these resources are lacking or in short supply, it hampers the students' efficacy to attain a height of competence in ICT, and this can hinder or reduce the chances of gainful employment

inworkplaces, since almost every sector is ICT compliant. Nwezeh(2010) points out that the availability and the opportunity to use computers in a university environment has potential influence on the use of electronic resources. Similar findings also indicated that lack of knowledge / competence in technology hampers the successful integration of ICT. (Rodden, 2010).

ICT shape up almost every aspect of an individual's life and also builds up an individual mentally, socially, financially and otherwise enabling such individual integrate fully into workplace. This view is supported by Oye, Lahad, and Rabin (2011) who asserts that Information and Communication Technology has the potential to make better all areas of our social, economic and cultural life.

1.2 Statement of the Problem

Inadequate ICT resources, skills and knowledge among students in Federal Colleges of Education as well other educational institutions have posed a major challenge to the maximum integration and utilization of ICT in Nigerian schools, and this could lead to incompetency in ICT among students. It is obvious that the level of ICT integration in Nigeria schools is not encouraging despite the level of attention attributed to it. This could also be due to factors such as lack of maintenance of ICT facilities, inadequate monetary allocation, inadequate skilled manpower and other factors, which has made the maximum integration of ICT into the educational sector not to be fully actualized.

Several factors among others which could increase the competency level of students include; adequate ICT resources, high rate of utilization,

interest and so on. Although the availability of ICT resources may not lead to students' competency since it could be available but not utilized effectively, and this could also hamper students' competency level in the use of ICT facilities. The study by Eze and Aja (2014) investigating the availability and utilization of ICT in Ebonyi Local Government Area of Ebonyi State revealed that available ICT devices in some schools were not adequately utilized due to lack of technical know-how. The effective utilization of ICT facilities can boost the competency level of students. Interest in the use of ICT resources also plays a vital role as it spurs students into using these facilities continuously. Kubiatko, Yilmaz and Halakova, (2012) stated that the continuous usage of computers influence the development of various computer related skills and techniques thereby enhancing an individual's knowledge of the computer entirely.

When students are not fully equipped with the ability to manipulate ICT resources, they will encounter a greater challenge in future when they are faced with ICT based issues, especially in work places, thereby making them redundant.The motive of this study is aimed at bridging the gap created by ICT incompetency and to determine the extent to which students' level of ICT competency can lead to improved performance in Biology and also equip students to fit into the continuous developing world of technology and into workplaces.

It is disheartening that students show nonchalant attitude towards ICT irrespective of its high placing as a tool for economic change and reform. Almost every sector is geared toward ICT integration, and the education sector

is not left behind as ICT is now used in the teaching and learning process in the classrooms.

ICT knowledge amongteachers in training has been seen as prerequisite in adoption and integration of ICT in the school system. It has been observed that in Federal Colleges of Education in Nigeria, ICT usage among the would-be teachers is still in its infant stage. The continuous development in the quality of education leaves room for improvement in order to meet up with the fast moving development especially in the technological aspect. This development cannot take place if the would-be teachers cannot adequately utilize ICT resources that will bring about quality instruction. Moreover, the use of ICT in teaching and learning of Biology brings home abstract objects and create better understanding of several biological concepts, leading to better performance in biology.

In recent years, huge amount of funds have been used in the procurement of ICT resources worldwide because of its importance in economic development, and Nigeria is not left behind because statistics have shown that the budget allocation for ICT in 2012 was 19.6 billion Naira, although it was reduced to 15.6 billion in 2013 and 14.6 billion in 2014 (Budgetary Allocations and ICT Development, 2014). If these funds are channelled to the educational sectors and well utilized for the procurement of ICT facilities, this will give the students the opportunity to have contact with these facilities thereby producing students with ICT skills and knowledge and also give rise to competency in the use of ICT facilities. This can also empower students technologically and bring about economic growth and national development.

In 2004, the Federal Government of Nigeria initiated the National Economic Empowerment and Development Strategies (NEEDS) in which Education and Information Technology were recognized as the means of growth and employment generation (NPC, 2004: PP 30).It is therefore important that ICT be fully incorporated into Colleges of Education and other institutions of learning for more effective and efficient instruction. This research is important as it will address the issues mentioned above.

1.3 Objectives of the Study

The major objective of this study is to assess the level of ICT competency among Biology students of Federal Colleges of Education in Kano state. Specifically, the study sought to achieve the following objectives:

1. To find out the availability of ICT facilities for use by the Biology students in Federal Colleges of Education in Kano State.
2. To examine the frequency at which the Biology Students in the Federal Colleges of Education Kano use ICT for their educational programmes.
3. To find out if there is any difference among the Biology students in gender, among NCEI, NCEII & NCEIII students and between the colleges in the level of ICT competencies.

1.4 Research Question

1. To what extent are ICT resources available for use by Biology students in Federal Colleges of Education in Kano State?
2. How frequently do the Biology students of Federal Colleges of Education inKano State use ICT?

3. What are the differences among the Biology students in terms of gender, level and between the colleges in their level of ICT competency?

1.5 Hypotheses

1. There is no significant gender difference among the biology students in Federal Colleges of Education in Kano State in their level of ICT competency.
2. There is no significant difference in ICT competency among NCEI, NCEII& NCEIII Biology students in Federal Colleges of Education inKano State
3. There is no significant difference in the level of ICT competency between the Biology students of Federal College of Education Kano & Federal College of Education (Technical) Bichi.

1.6 Significance of the Study

This research study has the potential to contribute to existing research in relation to the assessment of ICT competency among students in the following ways:

- The outcome of this study can be of use to the government, school administrators, lecturers, students, employers of labour, researchers and other stakeholders. Significantly, the result of this study may intimate the government on the inadequacy of ICT facilities in Federal Colleges of Education, and this could spur them into action in providing necessary ICT facilities that could help students attain a level of competency, which will equip and enable them cope with any

ICT based demands in future, and also provide a reliable data for government in planning and implementing ICT based programmes for students in Federal Colleges of Education and other educational institutions.

- The outcome of this study may also create awareness to school administrators, educational agencies, Federal and State Ministries of Education and other related bodies with regard to the level of ICT competency as this will enable them to formulate ICT driven programmes for students in Federal Colleges of Education thereby providing a platform upon which students can build on their level of ICT competency. It is hoped that the findings and recommendations of this study may create awareness to lecturers in Federal Colleges of Education in Kano State on the level of ICT competency of their students as this will make them give the students assignments and tasks that correspond with their students' ability to source for information using ICT facilities. It will also assist lecturers who are enthusiastic in delivering ICT based lectures in selecting the appropriate teaching style that can be accommodated with the students' ICT competency level. When students become aware of their own level of ICT competency, it would help them in assessing themselves in this aspect so that they can embark on further training so as to upgrade themselves in order to attain a height of ICT competency. This can also assist them in formulating and implementing ICT related policies when they find themselves in positions of authority in future.

- The outcome of the study may also be of significance to students of other institutions including universities, polytechnics, and even secondary schools, as the JAMB (Joint Admission and Matriculation) Examinations is now purely ICT based, being that students no longer use paper and pencil for the examinations, but computers, internet and other relevant ICT facilities. The knowledge of ICT even from the secondary level can assist students greatly in using the ICT gadgets during the JAMB examinations.
- It may also be significant to the employers of labour, schools and other educational parastatals so as to have first-hand information about the level of ICT competency of individuals from which they are likely to employ their staff.

Finally, the findings of this study could eventually be a source of reference for all stakeholders in the area of educational processes and products for planning befitting educational programmes for our nation in the nearest future. The study may also provide researchers in all areas of study with the opportunity to access empirical evidenced in their quest for further studies on the level of ICTs competency in Federal Colleges of Education.

1.7 Scope of the Study

The study investigates the level of competency among Biology students in Federal Colleges of Education in Kano State of Nigeria. The study also assessed the availability of ICT resources, the frequency at which the resources are used and the level of ICT competency among the students. The study covered the two federal colleges of Education in Kano state, namely;

Federal College of Education Kano and Federal College of Education (Technical) Bichi, Kano state.These Federal Colleges were chosen because no such study has being carried out in these Colleges.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents a review of literature relevant to this study, and is hereby presented under the following sub-headings:Concept of Information and Communication Technology, The integration of ICT in Education, Benefits of ICT Integration in Education, ICT Resources found in Schools, Factors Affecting ICT Utilization and Competency, ICT Competency needed by Students, Student's Attitude towards ICT, Review of Empirical Studies and Implication of literature Reviewed

2.2 Conceptual framework

2.2.1 Concept of Information and Communication Technology

The term Information and Communication Technology (ICT) have been given different definitions by various authors, which stems from its application in diverse fields as it transcends sectors and applications. There is a general misconception that ICTs refers to computers and computing associated activities; but this is not so because other technologies also play an important role alongside computers in modern information management, (Adu and Olatundun, 2013). The computer alone cannot work in isolation to bring about the desired ICT based outcomes, but it plays a central role in portraying and enhancing the smooth working of other ICT facilities such as the Interactive White Board, Internet, etc. Although there are other ICT facilities like the cellular phones, radios, televisions etc., which do not depend on the computer to function effectively. The computer and

other ICT facilities work effectively to bring about the dissemination of information and communication. In their own assertion, Oyelekan and Olorunde (2009) viewed ICT as the scientific methods of storing and processing information and also sharing, exchanging and sending or transferring such information from one place to another. They further stated that ICT should be seen not only be viewed from the ordinary use of modern electronic equipment like radio or television, but from the new communications and technologies that utilize the interconnectedness of the computer and other supporting facilities to process, manage and disseminate information, identifying the internet as the irrefutable single technology of this present age that drives the information and technology.

Information and Communication Technology is seen as an engine that drives all sectors in our contemporary world, including education, industry, government, health, law, banking, business, travel, engineering and so on, and has brought change in people's way of life (AyenagboKosi, 2015). The computer as an equipment plays a central role in the information technology process. ICT is the technology that backs up information activities which include gathering, processing, storing, presenting data, collaboration and communication. It assists people, firms and institutions in the use of information. ICT has become a building block of the contemporary age as it has become the basis and a key to societal, personal, educational economic and intellectual development. (Ngoma Sylvester, 2009).

Anuonye and Osuji (2011) describes ICT as a ‘‘ means of accessing or receiving, storing, transferring, processing and sending ideas, perception or information through computers and other telecommunication facilities’’. Azunku and Edigbo (2012) also describes information and communication technology as the use of wireless machines to develop, process, store and retrieve information, making use of the internet, computer and other related facilities.

ICT is defined by UNESCO, (2002) as ‘‘the combination of informatics technology with other, related technology specifically communication technology’’.

Types and Characteristics of ICTs

Iwu (2003) as cited in Afolabi, and Abidoye, (n.d)categorized ICTs into the following:

1. Sensing technologies: these equipments gather data and translate them into form that can be understood by the computer. These include sensors, scanners, keyboard, mouse, electronic pen, touch or digital boards, bar-code sensors or readers, voice recognition system, etc.
2. Communication technologies: These are equipment that enable information to be transferred from the source to user. It also tries to overcome natural barriers to information transfer like speed and distance some of these include: facsimile machines (fax), telecommunication system, telephone, electronic mail, teleconferencing, electronic bulletin boards, etc.

3. Display Technologies: These are output devices that form the interface between sensing, communication and analyzing technologies and human user. They include: computer screen, printers, television, etc.

4. Analysis technologies: These are the technologies that help in the investigation or query of data, analysis and in-depth query for answers for simple to complex phenomena in research procedures. A complete set of a computer system could be a micro, mini, mainframe or super scamper.

5. Storage Technologies: These technologies facilitate the efficient and effective storage of information in a form that can be easily accessed. They include: magnetic tapes, disks, optical disks cassettes, etc.''

2.3 The Integration of ICT in Education

"Information and communication technologies (ICTs) are a diverse set of technological tools and resources used for creating, storing, managing and communicating information. For educational purposes, ICT can be used to support teaching and learning as well as research activities including collaborative learning and inquiring". (Vajargah, Jahani and Azadmanesh, 2010). They continued that one of the major practical use of the ICT in higher education is teaching and learning based on these new technologies. UNESCO, 2004 also pointed that ICT in an educational context refers to a set of combined technologies that enables information processing and also its transmission for purposes of learning and educational development.

> *''ICT being an interdisciplinary domain focuses on providing students with the tools to transform their learning and to enrich their learning environment. The knowledge, skills and behaviours identified for this domain enable students to: develop thinking and learning skills that produce creative and innovative insights; develop more productive ways of working and solving problems individually and collaboratively; create information products that demonstrate their understanding of concepts, issues, relationships and processes; express themselves in contemporary and socially relevant ways; communicate locally and globally to solve problems; share knowledge and understand the implications of the use of ICT and their social and ethical responsibilities as uses of ICT. NCTE (2000: P18)''.*

ICT being an interdisciplinary domain can bring about holistic transformation of an individual giving an individual the ability to develop critical thinking, bring about innovations and solve related problems.

An important development in education globally is the use of ICT in facilitating the different aspect of education. Technology then should not drive education; rather, educational goals and needs, and careful economics, must drive technology use.Technology is a problem solving tool that addresses people's need, and when applied to the educational sector, educators should use it to solve educational challenges. Andoh (2012) is of the view that ICTs possess enormous potential for spreading knowledge, production of intended learning outcome, and the advancement of more efficient educational services. He continued that "Moreover, the adoption of ICT by education has been seen as a powerful way to contribute to educational change, better prepare students for the information age, improve learning outcomes and competencies of learners, and equip students with survival skills for the information society". It is therefore necessary for teachers to integrate ICT into their teaching and learning processes.

ICT-rich learning environment will produce ICT competent students capable of manipulative skills that will equip them to face the dynamic technological world.

The prudent use of ICT as an educational tool can enable developing countries to expand access to and to raise the quality of education, and this requires careful consideration of the interacting issues that underpin the use of ICT in the school-policy, infrastructure development, human capacity, language and content, culture, equity, cost, curriculum and pedagogy. (Olutunu, 2015).

ICT has made available innovative opportunities for teaching and learning and ithas engendered advances in research about how people learn, thereby causing a rethink in the structure of education. There is a general acknowledgment that ICT is a necessity and can be used to improve the quality of teaching and learning in schools. ICT has also made learning possible through multiple intelligence as ICT has brought about learning through simulation games; this enables active learning through all senses (Gateway, 2010).

The Educational Research Network for West and Central Africa (2006) grouped the theories and principles of pedagogical ICT integration into six main orientations for the utilization of ICT for educational purposes:

1. Adopt a critical and discerning attitude toward the pros and cons of ICT as a teaching and learning support, and critically assess the data gathered by networks;
2. Identify and evaluate the potential for information processing tools and networks to develop educational competencies;
3. Identify and communicate information using pertinent and varied forms of multimedia;

4. Use ICT effectively to research, interpret and communicate information and to solve problems;
5. Use ICT effectively to build networks for exchange and continuing education in specific subject areas for teachers, learners and pedagogical practitioners;
6. Tap into ICT opportunities for learning and assessment activities.

It was further stated that "pedagogical integration of ICT does not only mean the implementation of networks and equipments, but also the utilization of innovative technological techniques audio-visual, information processing and telecommunications to facilitate instruction at schools and in continuing education programs and for economic, social and cultural growth''.

Kozma (2008) in Rodden(2010) identifies three rationales for the introduction of ICT into education. ''Firstly, the economic rationalerefers to the role it can play in preparing students as future workers and in supporting economic development.Secondly, the social rationalewhere ICT investment aims to: increase knowledge sharing, encourage cultural creativity, increase civic participation, make government services more accessible and finally enhance social cohesion. Finally, the educational or pedagogic rationale, where ICT can advance educational reform and improve educational management structures.

The computer which is a very important ICT facility provide great advantages when used in education as it can present instructions using different types of media such as still pictures, motion pictures, slides, different types of graphic materials, models, audio materials and texts, creating a

variety of instructional activities, situations, interaction with students, etc. which provide quick feedback to students and evaluates the students' performance. (Abdullahi, 2013). The use of computers and other related ICT facilities during instruction cannot be overemphasized as it serves as a bedrock in simplifying instruction, providing an effective teaching learning process and encouraging individualised instruction which could lead to better performance among students and also increase the level of ICT competency among students.

2.4 Benefits of ICT Integration in Education

The benefits of ICT integration into the educational system are immense as theyaid effective teaching and learning. ICT resources are of great benefit and can be used to transform teaching and learning into meaningful practice, and is capable of meeting the learning needs of individual students, thereby promoting learning equality among students. Onwuzulike (2011) categorically stated that without pedagogical competencies by teachers, the many benefits of ICT cannot be realized. Teachers have important role to play in the actualization of ICT benefits. ICT can make the education system more productive as variety of resources are used to facilitate teaching and learning.

The benefits of ICT according to Nyenwe, and Ishikaku, (2013), Hennessy, Ruthven and Brindley, (2011), Adomi&Kpangban, (2010) and Mlao& Lee, (2010), are summarized as follows:

a. The use of ICT in education enhances speed and efficiency which leads to increased productivity.

b. It improves the quality of students' learning through their access to the required content through ICT facilities thereby promoting participatory pedagogy.

c. ICT promotes equity in education among male and female and increases access through the provision of educational opportunities to a greater number of people.

d. It serves as a means of providing wealth of information and learning resources to students by utilizing ICT facilities like the internet, CD-ROMs or DVDs and other facilities for learning at their pace.

e. The use of ICT facilities to learn enable students, when they graduate and find themselves in various workplaces, to have an edge over others who were less opportune to access ICT facilities while in school.

f. The use of diverse ICT tools can make the school more efficient and productive supporting and facilitating teachers' professional activities.

g. Utilizing ICT in the classroom for teaching and learning saves time and effort of both teachers and students.

h. It develops the ability of critical thinking and provide solution to educational challenges.

i. Through the frequent use of ICT, new skills and new pedagogic approach can be acquired.

j. It provides access to cheap learning and research resources.

k. It can make communication between student and teacher, teacher and teacher and teacher and student smoother and more effective.

l. The use of ICT provide a platform where scholars share with others their personal development in the area of discipline.

Other benefits according to Ebo, (2013), Tamunodienye, (2013), and Adjekpovu, &Imizuokena (2013) are:

a. ICT stimulates learners to learn actively and independently in a self-directed or in a collaborative way.

b. It is useful by students to create presentations and browse the internet to research for topics for papers and essay, thereby widening the horizon of knowledge.

c. Educational videos and games help children to learn even before they start school.

d. The use of projection screens linked to computers enable learners to see their notes and also listen at the same time to the delivery of lecture.

e. The use of ICT in teaching and learning motivates students to learn as it appeals to their sense of sight and hearing, and captures their attention, making instruction more effective and efficient.

Ashcroft (2004) as cited in Ugwuoke, (2011), also itemized some of the benefits of information and communication technology as learning and teaching resource as follows:

a. Helps to present information in many forms.

b. Makes learners to be more confident in learning process.

c. Communicates effectively on any process.

d. Makes students to become independent learners and good beginners.

e. Helps to increase students' writing skills.

f. Gives rise to greater problem solving and critical thinking.

g. Develops in the student the spirit to interact with their fellow students.

h. Helps students to work collaboratively.

From the above benefits of ICT it can be deduced that ICT can contribute immensely to Education and bring about positive change in the teaching and learning process when used in the classroom, and is therefore essential for it to be integrated into education for effective pedagogy.

2.5 Factors Affecting ICT Utilization and Competency

The role of ICT as a means of promoting development, improving organizational services, facilitating information delivery, enhancing teaching and learning process cannot be overemphasized. Irrespective of these, there are several barriers that inhibit the actualization of these great roles that ICT plays in schools today. Some of the barriers to be discussed include:

a. Erratic power supply: The problem posed by erratic power supply is one of the major problems that has hindered the integration of ICT in Nigerian schools today. Without constant power supply ICT facilities even if available in great numbers, cannot function. Nigeria as a developing country is faced with the problem of inadequate power supply, and the use of generators in schools is very expensive as the cost of fuelling the generators is high, and also the unsteady fuel supply has posed a challenge. If the Power Holding Companies in Nigeria can liaise with schools to provide power, then the problem will be reduced to a bearest minimum, or alternatively, other sources of power supply like the solar can be installed in schools to help run the

ICT facilities in case of power interruption. (Nyenwe, and Ishikaku, 2013).

b. **Cost of Equipment:** The cost of ICT equipment which is at a high rate is a problem in the integration and utilization of ICT in schools. Some schools are not capable of purchasing adequate ICT facilities that can cater for the needs of the students, and this has posed a great challenge as it deprives such students from having full access to these facilities as they are not readily available, thereby making them unskilful or incompetent in the use of ICT facilities. Most times, the ratio of the equipment to the number of students shows a very wide margin as only few ICT equipment are present and cannot be equated with the number of students that are to use them. This reduces student's access to these facilities causing them to pass out of school without the full knowledge of the use of ICT facilities. (Rodden, 2010).

c. **Absence of/slow internet connectivity:** Many schools in Nigeria are often faced with the problem of slow internet connections which hinders adequate utilization of internet facilities for ICT activities. Due to high cost, internet connection is restricted to few places like the library and ICT centre, but absent in departments, faculties and classrooms where it is also of utmost importance. Most times, the internet connectivity fluctuates and may also be very slow and frustrating, hindering students from having full access to the World Wide Web.

d. **Poor Funding/Inadequate Monetary Allocation:** The allocation for ICT in some schools cannot meet the demand as funds is needed for

the purchase of equipments, maintenance of such equipments, and also for the training of staff. As a result of too much pressure on the school budget, the tendency of allocating adequate funds for ICT facilities may not be achieved. Poor funding can lead to poor utilization of ICT facilities and reduction in basic ICT skills which will also affect the level of their competency. ICT gadgets can be extremely expensive, both to purchase and maintain. Unfortunately, finance determines the quality and quantity of hardware and software in most schools (Rodden, 2010). A research conducted by Akuegwu, Ntukidem and Jaja, (2011), in universities in Akwaibom and Crossriver states showed that the reason for the low availability of ICT facilities for quality instructional service delivery results from inadequate supply of these facilities coupled with poor funding of education by federal and state governments. The poor funding resulting from inadequate budgeting allocations to education.

e. **Inadequate Technical/Skilled manpower:** The problem of inadequate technical personnel in Nigerian schools have attained a discouraging height as there are litters of non-functional ICT facilities in faculties, departments, e-libraries, offices and so on. This constitutes a big challenge as there is no management or repair of the available facilities. Trained ICT technical personnel are needed to help students to make maximum use of the ICT facilities in the schools. (Ugwuoke, 2011).

f. **Lack of access to ICT resources:** Lack of access to ICT resources is another important barrier to the utilization and integration of ICT in

schools. Various studies have shown that lack of access is the greatest barrier to ICT integration, and the lack of access included a lack of computers and a lack of adequate material. Rodden (2010), is of the view that if there is difficulty in accessing ICT resources, then there will be difficulty in integrating these resources into the learning process, although his view contradicts that of Becta 2004 as cited in Rodden (2010), which pointed out that the inaccessibility of ICT resources is not always associated with the absence of it, but other factors such as poor allocation, poor quality, inappropriate resources or lack of access for teachers can also be the cause.

g. Expensive Modem/Data bundle: it is obvious that the high cost of modem which ranges between N5000 and upwards has made it difficult for many students to purchase. Also, the expensive data bundle is not helping matters as it easily gets exhausted when downloads are made. (Bugaje, 2015). This is a serious barrier to ICT utilization as it hampers student's opportunity to dive into the internet world and explore through wealth of information.

h. Lack of Knowledge and competence

Lack of knowledge and competency is a teacher related barrier to ICT integration. Bingimlas (2009) points out that teacher's competence refers basically to the ability to integrate ICT into pedagogical practice. The non-integration of ICT in education could be as a result of lack teacher's knowledge and skills in the use of ICT. In proffering solution to this barrier, there should be periodical training and workshop

organized for teachers, as this will provide them with ICT knowledge that can be beneficial to the students.

i. Lack of Time

Various studies have shown that lack of time can hinder the effective use of ICT in teaching and learning even when the teacher is competent and confident to deliver instruction using ICT. Haydn and Barton(2008), describes teacher time as ‘‘a very precious resource in education’’. Teachers need time to surf the internet for information, prepare lessons, test run the lesson using ICT gadgets and set up the gadgets before the start of lessons. A teacher may not be able to use ICT in class because of the inadequate time available for executing these tasks. Also, there may not be time to train ICT incompetent teachers, as they need assistance and support to get familiar with the use and application of ICT during instruction. When teachers are not able to use these facilities to teach, students are less exposed to these facilities, thereby hampering their access to ICT resources.

j. Lack of Confidence/Fear

Lack of confidence and fear is a great barrier to the integration of ICT in education, and various studies have shown that it prevents teachers from using ICT in the classroom. When the teacher feels incompetent, He/she becomes anxious and feels that the students will notice His/her unskilfulness in the use of ICT, as that could bring down their high esteem before the students, being that some students already make use of modern ICTs. Furthermore, Rodden (2010) stated that ‘‘the constant use of modern technology by students puts teachers even

under ever increasing pressure, by almost demanding that they be knowledgeable and proficient in the use of ICT''.He further stated that meaningful training and professional development can increase teacher confidence and reduce these feelings of fear and anxiety.

2.6 ICT Resources Found in Schools

Akinola(2005) as cited in Bugaje (2015) identified different kind of ICT resources which include:

a. Computer systems: -computer systems are electronic devices that are able to store data, perform computation on such data and also retrieve information on such data at a very high speed. It can also be defined as a general purpose device that can be programmed to carry out a finite set of arithmetic or logical operations. The computer accepts data and manipulates it into usable information. It cannot do anything on its own, but work based on instruction(s) imputed into it. This set of instruction is referred to as a **program.** The computer is the major component of ICT.

b. Networking: -Networking is the process of inter-connecting two or more computer systems linked together. Networking is very essential as it makes information sharing possible. Some types of computer networks include the following

i. Local-area networks(LANs):-All the personal computers are geographically close together i.e. under the same roof to share the same peripherals. Example could be the networking of lights, printers, group of PCs in an office, etc., and is usually connected by cables.

ii. Wide-area networks (WANs):-The computers in different places are connected by radio waves or telephone lines.

iii. Campus-area networks(CANs):-The computers are confined within a limited geographic area such as a campus or military base.

iv. Metropolitan-area networks(MANs):-A data network designed for a town or city.

v. Home-area networks: - (HANs)A network contained that connects digital devices within a user's home.

c. Internet: -Otherwise referred to as the Net, as a short form of Network.

Akinola in Bugaje (2015) defines the internet or simply the net as a global collection of many different types of computers and computer networks that are interconnected together. The internet connects millions of computers. It is the global system of interconnected mainframe, personal, and wireless computer networks that use the internet protocol suite (TCP/IP) to link billions of devices worldwide. The internet is referred to as ''the mother of all networks

d. The Electronic mail (E-mail):- The term Electronic mail is commonly used to refer to mails exchanged through computer system (James, 2010). It was further stated that the E-mail system requires a communication network and the necessary hardware and software for sending and receiving mails. The E-mail services is the most widely used service in the internet. Davinder, (2004) also defines the electronic mail as a transmission of messages and files via communications network, such as a local area network or the internet,

usually between computers. He further stated that it has become the fastest and the cheapest means of sharing text messages.

e. **Fascimile Transmission (FAX):-** A fax (short for fascimile and sometimes called telecopying is the transmission of scanned-in printed material (text or images), usually to a telephone number associated with a printer or other output device.(Rouse, 2006). She added that the original document is scanned with a fax machine, which treats the contents (text or images) as a single fixed graphic image, and converts it into a bitmap. The information transferred in digital form as electrical signals via the telephone system. The coded image is reconverted and printed in a paper through the receiving fax machine. This can be done within seconds and can be received anywhere in the world.

Furthermore, Adjekpovu, and Imizuokena (2013), identified the **Interactive White Board (IWB)** as a type of ICT resource. The Interactive White Board is used as an instructional tool or stand mounted on the wall and is connected to a computer to display images from the computer's desktop onto the surface of the board, and can be controlled by the use of pen, finger, stylus or other device. The IWB support the use of multiple users at the same time. Daniel, 2009 as cited in Adjekpovu et al, (2013) states that the interactive white board has replaced the traditional whiteboard, flipcharts and Video/media system.

2.7 ICT in Biology

The use of ICT in Biology teaching is very essential as it makes the learning of difficult and abstract topics easy to understand and interesting. There are numerous prepared videos and Power point presentations on different biology topics which when used in the classroom, makes the lesson interesting and captivating when displayed using the projector and the interactive whiteboard. The use of animated simulation in the classroom is wonderful and exciting for the learners.

Mamodou and Ngamo, (2010) mentioned that in the case of biology, so many simulation tools are available on mitosis, cell movement, phagocytosis, the uptake of CO_2 by plants growth or action of certain substances on plant development, etc. The use of ICT in teaching biological concepts is beneficial to both teachers and learners, as it improves the skills of biology teachers as they use it in their educational practices and also help students to learn with ICT, familiarizing themselves with ICT as they carry out learning activities and exercise critical judgment toward the information they find in the internet. They also identified 5 fundamental pedagogical principles that must be applied in teaching biology:

1. Developing basic and essential ICT competencies, with an emphasis on computer literacy. Introduction to ICT instructions and tools (familiarity with common software such as word, Excel and filing educational materials, compiling and organizing information.
2. Choosing the appropriate tools for a given task, integrating a number of tools to solve actual problems, and using them on every day basis in a critical and productive way to serve as a model for the students.

3. Using a diversity of ICT software to teach, learn, communicate and solve problems in different subjects, and adopting clearly expressed, critical stance toward these technologies.
4. Developing projects and the accompanying documentation (e.g worksheets digital portfolio) that integrate various aspects of the course content and extend the meaning of the information beyond the classroom.
5. Evaluating the learning achieved through specific questions, effective work processes (e.g., integrated online self-evaluative learning, access to glossaries and extra class notes at internet-accessible hypertext sites, etc.).

Biology students in Federal Colleges of Education are the future teachers and educational administrators and should therefore be well equipped with ICT skills and literacy in order to produce ICT competent student-teachers that can apply these skills and competencies in their workplaces thereby bringing about economic development.

2.8 ICT Competency Needed by Students

The term competency have been defined by various authors in different ways.

For instance, Hornby (2000) has defined competency as the ability to do something well in a particular job or for a particular task. Furthermore, Ozioko, Ezeani and Ugwu (2009) in Ugwuoke (2011), view competency as the required skills possessed by some people or those expected to be possessed by them in the discharge of their professional duties. The world we are today

is a world of technology, and students that are not technology inclined will begin to lose track of events. In connection to this statement, Ofoegbo, and Asogwa (2013), pointed out that ICT competencies are required in every sphere of life in order to fit into the digital world.

The issue of competency in ICT should be a priority in this current dispensation owing to the fact that every aspect of life is being linked directly or indirectly to ICT. World bank as cited in Adeyomo (2010), clearly states that the benefits in the use of ICT in education is fast gaining recognition globally and is becoming one of the vital elements defining the basic competencies of students in this present dispensation and have been presented as five central skills as follows:

a. ‘‘Information skills (Literacy): skills concerned with the ability to gather, edit, analyze, process and connect information.
b. Higher order thinking skill in particular problem solving, critical thinking, creative and enterprenueral thinking.
c. Communication and cooperation skills: the ability to work in team and to belong to various communities
d. Skill to use technologies tools despite the feeling that young people know how to do this.
e. Learning skills: in particular the development of individualistic learning.’’

Continuous usage of computers influence the development of various computer-related skills and techniques thereby enhancing one’s knowledge of the computer entirely. (Kubiatko, Yilmaz&Halakova, 2012).

ICT components according to Ocholla in Ugwuoke(2011) include additional and new competencies like computer literacy, word processing,

spread sheets, database construction and management, online searching and retrieval, CD-ROM awareness services. Others are electronic current awareness service, automation indexing and abstracting, text digitization, desktop publishing, electronic publishing, design and administration, fascimile transmission and archiving of electronic and audio visual documents. The use of technologies requires skills and competencies which the student must acquire (Etiubon, and Etiubon, (2013). They added that, this will help them compete in a digitized and networked society.

According to Danner and Pessu (2013), 'it is unavoidable for students to use different information communication technologies in learning. Students can get information quickly when they use modern ICTs. They can assess and spread widely electronic information like e-books and e-journals and can become better when they make use of variety on modern ICTs like wireless, and web 2.0 technologies.The reason for changing education could be as a result of the continuous rapid change in the world which requires new skills and knowledge, expecting learning institutions to equip learners for the 21st century to enable them adapt to the advancing changes in technology. Educational technology and ICT is very important in producing an operative and suitable learning environment (Andreja, 2010). Skills developed by students through the use of ICT can be applied across all areas of learning. Students can use ICT to access data and information from various sources when they encounter certain educational problems.

In the olden days, it was hectic to embark on researches, have easy access to journals of choice, and follow current technological issues. But in this present dispensation, it has been made easier through the use of ICT. It

has also been emphasized by Apagu and Wakili (2015), that with the view of the function of education in national building and the high population in technical colleges in this present dispensation, it is vital to utilize ICT during teaching and learning. Student's knowledge of ICT will assist them in carrying out researches, making online inquiries, carrying out school registrations which is now purely online, searching for relevant information for their assignments and presentations, downloading necessary information that will enhance their knowledge.

> *"Students develop competence in using ICT for tasks associated with information access and management, problem solving, decision making, communicating, creative expression, and empirical reasoning. It is also essential that students develop knowledge, skills and understanding around the fundamental logic and conventions underpinning ICT use and the ability to transfer these from one ICT environment to another (such as from school to workplace and to other social contexts). Equally important is the manner in which ICT is used, based on an understanding of the technology's limitations and its impact on individuals, groups, communities and organisations. (Acara,2010: P2)''.*

From the above statement it can be deduced that the continuous use of ICT by students enable them develop competency and also transfer such knowledge to other related areas for personal and general growth, both in the education sector and workplace.

It was further stated that students develop ICT competence when they:

- Apply appropriate social and ethical protocols and practices in managing and operating ICT
- Manage and operate ICT: applying technical knowledge and skills; managing data and information efficiently, effectively and appropriately and interacting with ICT for learning

- ❖ Investigate with ICT: planning and refining information searches; locating and accessing different types of data and information and verifying the integrity of data when investigating questions, topics or problems
- ❖ Create with ICT: using ICT to generate ideas, plans, processes and products to create solutions to challenges or learning area tasks
- ❖ Communicate with ICT: exchanging ideas and information with others while adhering to social protocols appropriate to the communicative context (purpose, audience and technology).

Adeoye, Folami and Houston (2010) opined that the possession of ICT skills and competency gives an individual an edge over another. This implies that an individual that has the knowledge of ICT has better chances of employment and providing solutions to ICT based problems than an individual who lacks such knowledge.

According to Hew and Leong (2011), ICT competencies play a vital role in developing a nation, and with the increasing utilization of ICT in education all over the world, new skills and competencies among students are essential for them to learn more effectively. Without ICT skills and competencies, a nation will remain under-developed.

2.9 Use of ICT

The use of ICT cannot be overemphasized as it is an essential tool both within and outside the school environment as it is used to carry out so many activities within the school environment that will enhance students' academic

performance and ICT skills and also helps the students after graduation in their workplaces.

IN SCHOOL

a. Ability to carry out Educational Researches

Research is the systematic investigation into and the study of materials and sources in order to establish facts and reach new conclusions. "In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge." (Martyn Shuttleworth, 2008). In the school environment, students are often faced with diverse challenges in form of assignments, projects, presentations, etc. In order to tackle these challenges, students resort to carrying out researches either using the internet or library or both. The internet has become the most used means of gathering useful information in any field. It can be assessed by students anytime, anywhere and within short time. Fortunately, internet facilities are available in most Nigerian schools where students have free access to internet services or pay meagre amount to access the internet. Furthermore, the mobile phones can also be used by students to carry out researches at their convenience. Millions of students and trainees participate in education and training programs to acquire knowledge and skills that may have future application. In the workplace and in everyday living people seek that specific knowledge and skill when and where they need it. ICT makes available and accessible just-in-time information and knowledge and provides opportunities for continuing life-long learning. Amal and

Miliszewska(2014), are of the view that the attitude and beliefs of students toward e-learning, their satisfaction with technology and their previous e-learning encounter will determine how successful their future e-learning initiative will be.

The continuous access to the internet and its use by students to carry out researches will help to improve their knowledge in the use of ICT facilities and the increased access to wealth of information and learning resources and will also encourage for learning at one's pace. This can also lead to increased performance in the area of study. These wealth of information can be retrieved through different search engines from well- developed and organized websites and online publications at any time it is needed.The use of social media such as Facebook, Whatsapp, Instagram, Twitter, E-mails and the rest of them have made communication as swift and efficient as possible unlike in the olden days when delivery of vital information was very slow and hectic. Through the help of technological advancements, messages can be sent within few seconds across wide range of distance within or across countries with a little amount to loose.

Students can also share relevant ideas and information related to their studies through these social media. ICT provides access anytime and anywhere by making possible asynchronous learning, and offering access to online materials 24 hours a day, 7 days a week.

b. Ability to make PowerPoint presentations

The PowerPoint packages can be used by students to create slides for presentation. Presentation is a concise step by step tutorial

enhance with visual aids like graphics, charts picture, and videos to pass a clear message to a specified audience. PowerPoint is a presentation software by Micro Cooperation. It helps students to create dazzling slide presentation that can be displayed in a variety of ways. The course of preparation of slides for presentation by students can help in increasing their level of competency, especially when they are often given assignments to be presented using the PowerPoint package. In the course of trying to prepare an enriched and appealing slide the students practice diverse methods to come up with a wonderful package, and this helps to improve the student's knowledge on the use of PowerPoint for making presentations thereby equipping such students for the future. Students often respond better when instructors have designed sessions for greater classroom interaction, such as the use of student response clickers, designing PowerPoint to facilitate case studies, or use the slides as a replacement for paper worksheets.(Karen Smith, 2016). It has been noticed that some students find it strange when they are asked to make presentations using the PowerPoint package, and they run helter skelter looking for solution, but when these students are well equipped for the future, it will be a walk over.

c. Ability to use Databases

A database is an organized set of data that is stored in a computer and can be looked at and used in various ways. Database is a collection of inter-related information that is systematically arranged and can be easily retrieved. It is a repository of information that is required for

the operation of an organization. It also comprises of different field names in which records are stored, for easy reference and retrieval. Database on the internet can give educational information to students. A database is a collection of information that is organized so that it can easily be accessed, managed, and updated. Databases can be classified according to types of content: bibliographic, full-text, numeric, and images. But strictly defined, databases are computer structures that save, organize, protect, and deliver data. A system that contains databases is called a **database management system**, or DBM. The typical diagram representation for a database is a cylinder. "A school's effective use of data can enable the successful identification and implementation of appropriate strategies ultimately leading to standards attainment and student learning increases. Bernhardt Victoria, (1999)".

d. Ability to browse the Internet

The Internet has brought about great changes in many aspects of our daily lives. It has affected the way we do business as well as the way we carry out our daily activities. There are several services the internet provides such as sending electronic mail, performing money transfer from one bank to another, recharging of TV cables, reading newspaper from the net, booking for flight online, shopping for a variety of products such as phones, cars, cloths, shoes and so on, searching for jobs online etc. The Internet is a communication system that has brought a wealth of information to our finger tips and organized it for our utilization. (Ugwuoke, 2011). This enables students to search for information online thereby increasing their frontiers of knowledge and skills even at their own leisure.

In 2006, the Internet celebrated its 37th birthday. In the space of only a few short years, this tool that was initially possessed by the army and later by the universities, has increasingly become a familiar tool used daily by individuals on every continent.

e. Ability to use Graphic Software

Graphic software, also referred to as editing software is a program or collection of programs that enable a person to manipulate visual images on a computer. Here, the student can create and manipulate any type of computer graphics from sources like video, images and drawings. They are usually used for editing and showing digital photos, creating logos, drawing and modifying clip art, designing advertisements and product packaging, touching up scanned photos, and drawing maps and other diagrams (Chastain, 2014). The CorelDraw is one of the commonly used graphic software. According toGordon and Gordon (2002) The Use of graphic art software may be more efficient than rendering using traditional media by requiring less hand–eye coordination, needing less mental imaging skill, and utilizing the computer's quicker (sometimes more accurate) automated rendering functions to create image.

OUT OF SCHOOL:

a. Integration into workplace

In the context of this research, the word ‘‘workplace’’ is synonymous to gainful employment, and is referred to as a place where a person does a job to earn a living (Oxford Advanced Learner’s Dictionary). The workplaces in this dispensation are technologically inclined as ICT gadgets are now used to carry out most of the task. For

instance, workplaces like Banks, Industries, Schools, etc. carry out their functions using ICT based facilities. In most organizations, ICT literacy and competency is a prerequisite for gainful employment. A student without the knowledge of ICT cannot integrate into major workplaces, and this could lead to unemployment or unavailability of desired jobs. Haliso (2011) stated that a good background in computer skill makes the use of computer very practical in work places. He further stated that it is very important to train workers on the use of computers and other related technologies, as a well-trained worker can efficiently and effectively perform better in his/her workplace than an untrained worker.

b. Integration into the dynamic ICT world and the 21st century technological advancement

The ICT world keeps changing and transforming into a better and more sophisticated technological world. The type of ICT facilities used some decades ago may have been outdated or improved upon to suite the current technological demands. Nyenwe and Ishikaku (2013) pointed out that over the past 35 years the use of ICT has been the most remarkable and transformative technology in different area of development and that the advancement has brought about the invention of assorted ICT gadgets that are important in the developmental process.

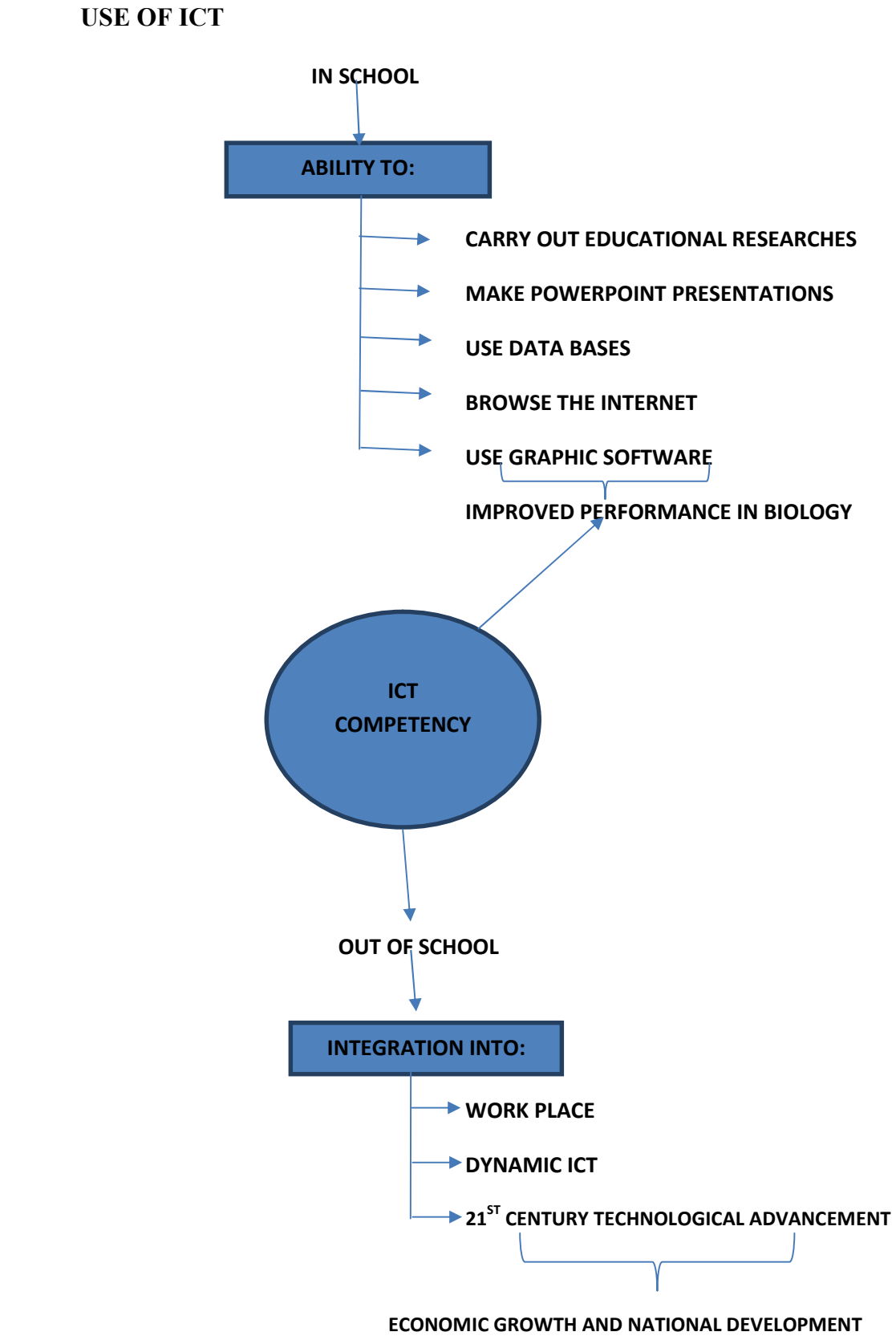

FIG. 1: ***PICTORAL PRESENTATION OF USE OF ICT***

2.10 Students' Attitude TowardsICT

The concept of Attitude have been defined by different authors in different ways. Kassin (2008) defines attitude as relatively enduring beliefs influencing the manner in which people do things and the outcome of their actions. Attitude affects the way people do everything and it reflects who they are and is therefore a determinant of people's behaviour.

Maio and Haddock (2010) defined attitude as "An overall evaluation of an object that is based on cognitive, affective and behavioural information". He explained that the cognitive component of attitude is what the individual thinks or believes about an object while the affective component is the feelings or emotions of the individual associated with the object. The behavioural component is the tendency to act in a certain way to the object. He further stated that students' attitude toward computer education could be positive, negative or ambivalent.It is observed that students are influenced by ICT to a large extent and successful integration of ICT into the educational system depend greatly on the student's attitude towards them. Students act or react differently towards the computer which is the major component of ICT. Kubiakto et al (2012) defined the computer attitude as a person's general evaluation or feeling of favour or anthipathy towards computer technologies and specific computer-related activities. The different feelings students have towards ICT also have an effect on their reaction towards it. There is a positive correlation between positive attitudes towards computers and the students' success in both the subject matter learnt and the use of communication technologies. (Levine and Schmidt, 1998). It has also been observed that the frequent positive use of ICT enables an individual to develop

positive feelings towards it and also lead to the development of various ICT related skills and competencies (Garland and Noyes, 2004). Students that show positive attitudes towards the use of ICT in education have been found to have better performance than those who show negative attitude towards it. (Nayeshi, Chen, Ryan and Wu, 2004).

The development of ICT skills and competencies can enable students have positive attitude towards Biology using ICT which can in turn lead to better performance when applied in biological concepts. In a study investigated by Haunsel and Hill (2012), it revealed that pupils using computers had more positive attitude towards biology and natural sciences than pupils who do not learn with computer.

Various research studies have shown that males and females show differences in their attitudes towards specific ICT activities. The study of Kubiakto (2010) shows that males have more positive attitudes towards ICT for teaching and learning Biology as compared to females, leading to higher competency among males in the use of ICT. This finding also support the common view that "males are technically more competent than females". Although other studies have revealed otherwise.

2.11 Review of Empirical Studies

Some related studies have been conducted by researchers both within and outside Nigeria on ICT competency , some of which include: In a related study, Danner and Pessu (2013) on a survey of ICT competencies among students in Teacher Preparation Programmes at the University of Benin, Benin city, Nigeria. A descriptive survey research was used. The population of the

study was all the undergraduate students in teacher preparation programmes in the five departments in teacher preparation programmes in the five departments in the faculty of education in the University of Benin, and a sample of 100 undergraduate students were selected for the study. Data collection was carried out with the instrument called Students ICT Usage and Perceived Competencies Inventory (S-ICT-UPCI). Descriptive statistics (Frequencies, percentages, cross-tabs) and ANOVA were employed in the analysis of data using the statistical package for Social Sciences (SPSS) version 16.0 to answer the three research questions.

The findings showed that the students perceived themselves to be competent in the use of word processing and file navigation. A lower proportion of students perceived themselves to be broadly good in internet browsing and emailing. 70% of the respondents had no capability at all in the use of Power point presentation tool. It was also discovered that only 2% of the respondents considers themselves to be excellent in the use of power point. It is evident from the literature that unless the issue of ICT competency is addressed, it can itself be a barrier to students learning. It was therefore suggested that special funds be created to revamp the e-learning support centres at the faculty level for students and faculty staff use.

In a related study Dincer andSahinkayasi(2011) sought to examine a cross-cultural study of ICT competency, attitude and satisfaction. The data was collected from a survey which consists of four parts with open and closed-ended questions. 440 students studying at universities in Turkey, Poland and Czech Republic participated in the study. Independent - samples t-test and Pearson Product-moment correlations were performed using SPSS 17

software, statistical package program in order to treat the research question which examined the similarities and differences between students in EU candidate Turkey and new EU members Poland and Czech Republic. Findings of the study showed that although Turkish students began to use computer and internet later than Polish and Czech students, no difference was seen between them regarding their computer competency. The findings also revealed that the Turkish students use computer and internet for a shorter time than Polish students but for a longer time than Czech students. It was noted that these differences are associated to fields rather than to countries because Turkish students studying at departments used computer and internet for academic purposes while polish students use computer and internet for social websites and for surfing on diverse websites. It was therefore suggested that the reasons of computer and internet use should be reconsidered in connection with countries' socio-economic structures.

In another study, Walcott, Naele and Depradine (2013) studied The ICT Competencies of part-time students at a Tertiary Institution in Barbados. The population for the study consisted of a sample of 105 part-time established students. A survey or descriptive research design was used in this study, and the instrument used for data collection was a closed-ended questionnaire (ICTCQ). The instrument divided into four sections was constructed and validated with a reliability coefficient between 0.868-0.920. There were 6 research questions and the data retrieved to answer research questions 1-3 was analysed using the mean values and standard deviation. The t-test of independent samples was used to answer research question 4, while the linear regression was used to analyse research questions 5 and 6. The

findings revealed that from the self-reported ICT competencies of the part-time students, the skills examined which included word processing, presentation software, spreadsheets, maintaining a computer and securing a computer, it was found that although a large percentage of the students were skilled or very skilled at word processing. Many of these students were not competent in securing their computers, in using presentation software, in maintaining the computers and in using spreadsheets.

Chukwudi, Izang and Olufunbi (2015) investigated Information and Communication Technology (ICT) Competence and Literacy among Undergraduates as a factor for Academic Achievement. A sample of 300 students (170 students from Badcock University and 130 students from Tai Solarin University of Education) were drawn from a population of 10,713 students. Descriptive survey design was employed for this study. Well-Structured questionnaire was used as the mean instrument for obtaining primary data. The findings of the study shows that over 80% of the students from the two schools are competent in the use of ICT.

Yusuf and Balogun (2011) investigated Student-Teachers' Competencies and Attitude towards Information and Communication Technology. 382 student-teachers from the Faculty of Education University of Ilorin, Nigeria were used as sample. The data was collected using questionnaire and the data collected was analysed using percentages, means and chi-square statistics. Findings of this study revealed that majority of the student-teachers have positive attitude towards the use of ICT and are competent in the use of basic ICT tools. The study recommends that there is need to introduce student-teachers to more courses on ICT with needed hand-

on experience in order to promote effective integration of ICT throughout the curriculum by student-teachers. It also added the need for teacher educators to model good use of ICT in their instruction.

Hew and Leong (2011) conducted a research on "An Empirical Analysis of Malaysian Pre-University Students' ICT Competency Gender Differences". 208 respondents were used as sample of this research. Random sampling technique was also used. The questionnaire was used for data collection. The reliability of the questionnaire used was tested using Cronbach's Alpha. An Alpha value of 0.70 was obtained. The result was analysed using descriptive statistics (Mean and Standard deviation), non-parametric test (Mann-Whitney test statistics, Spearman's Correlation Coefficient). The findings indicated that statistically both genders do not have significant gender difference in eight out of nine ICT Competencies, the male students still have a slightly higher mean score in all the ICT competencies except the word processing competency, where the female have a higher mean score. It is therefore recommended that teachers and instructors must try to apply versatile methods of teaching which are more student centred such as cooperation and teamwork. This will help them to eliminate the gender difference where the male students will guide the females to master the PC maintenance skill.

Wong and Cheung (2013) in investigating Gender Differences in ICT Competency for University students of Different Disciplines used a summative assessment design without control group. The sample included 640 students from 24 undergraduate programmes. Independent sample t-test were used to analyse the research question "there is no significant difference in ICT

Competency between male students and female students''. The result revealed that females' scores were higher than males' scores on five assessment components out of seven with statistical significance. Therefore, the findings are in contrast with the widespread belief that male students usually perform better in ICT courses.

Luan, Aziz, Yunus, Sidek, Bakar, Meseran and Atan (2005) carried out a study on Gender Differences in ICT Competencies among Academicians at University Putra Malaysia. The study was a descriptive survey. A total of 109 academic staff participated in this study. T-test was conducted to determine if differences existed between male and female in their ICT competencies. The result shows that there exists a gap between female and male academicians; in certain cases, the competencies of female academicians have even surpassed those possessed by males.

Anyamene, Nwokolo and Anyachebelu (2012) investigated the Availability and Use of Information and Communication Technology Resources for Counselling University Students in South East States, Nigeria. Proportionate stratified sampling was used to select 10,800 students from the 9 universities. The instrument was a structured questionnaire which was validated by two experts in guidance and counselling. One from NnamdiAzikiwe University, Awka and the other from Ebonyi State University, Abakiliki. A test-retest method of reliability were used for data analysis. The results indicate that Information Communication Technology (ICT) facilities for counselling are limited in the universities in the south east states, Nigeria. The results also indicate that the level of Information Communication Technology is low. Based on the findings of the study, it was

recommended that government should make available ICT facilities in counselling laboratories in all Universities in other to help facilitate counselling and learning.

Eze and Aja (2014) investigated the Availability and Utilization of Information and Communication Technology (ICT) in Ebonyi Local Government Area of Ebonyi state: Implications for effective teaching and learning. Four research questions served as guide to the study. 360 respondents were sampled randomly from the population. The instrument used for data collection was a 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. Mean scores was used to analyse the data collected. The result revealed that Information and Communication Technology (ICT) devices are available but not adequate in most secondary schools studied in Ebonyi Local Government Area of Ebonyi State. The available ICT devices in some schools were not adequately utilised due to lack of technical know-how, and most of the devicesavailable are not in good working conditions because of absence of electricity, internal connectivity and maintenance culture. The following was recommended for proper application of ICT in our school system:

- Policy on ICT in school be reviewed and fully implemented
- Non-governmental agencies and wealthy Nigerians should participate in the provision of ICT devices in secondary schools.
- There should be checks on how the money and ICT equipment provided in schoolsare used.

Adamu (2012) in his research investigated the availability, accessibility and usage of information and communication technology (ICT) among students of technical education in Niger State tertiary institutions. The survey research design was used and a structured questionnaire was used for data collection. The population of the study comprised all the 1161 students of technical education department from the two tertiary institutions offering technical education programmes in Niger State. Four research questions was developed to guide the study. The findings of the study revealed that ICT facilities are not available for students' use at the department and as such they don't have access to it. In terms of usage, the students in most cases make use of commercial cybercafés for the purpose of school registration and thus there is poor usage of ICT for academic purposes. Based on the findings, some recommendations were made which include the urgent need for the department to make ICT facilities available and easily accessible for the students and also to make it compulsory for students to create email address and also present assignments/course projects through packages like power point projection.

Tella (2011), in his study investigated the level of Availability and Utilization of ICT facilities among students in some South-western Nigeria Colleges of Education. The data for the study was collected using the questionnaire. 200 respondents were sampled for the study and the data collected was analysed quantitatively. The study revealed low level of ICT facilities utilization and the non-availability of ICT equipment. Based on the result, it was recommended that ICT facilities should be made available for effective teaching and learning.

Adetimirin (2012) in his study investigated the Availability, Use of Information and Communication Technology and the ICT Literacy skills of Undergraduates in seven Nigerian universities. The descriptive survey research design was used and seven universities were selected based on distribution of ownership of university. Four faculties were purposively selected with a population of 8,497. Random sampling procedure was employed using a sampling percentage of 20% to give a sample size of 1,702. The results obtained revealed that computer, telephone and the internet were the three ICT facilities mostly used by the respondents. The undergraduates in the state universities (BSU & IMSU) were found to have poor ICT literacy skills in the use of the three ICT with over 25%, while those with average ICT literacy skills were in the federal universities (ABU & UNIMAID). The three major factors affecting the ICT literacy of the undergraduates were identified as irregular power supply, inadequate ICT and limited duration of the use of ICT. Based on the result of the study, recommendations were made for increased ICT literacy of undergraduate, the university administrators must introduce courses on ICT competency to all students especially first year students and encourage all lecturers to use ICT for teaching and learning.

2.12 Implication of Literature Review

The study has reviewed the literature on the previous works done relating to the level of ICT competency among students. The study also reviewed previous works on availability of ICT facilities, students' frequency in the use of ICT facilities for their educational activities and their attitude towards ICT. Findings from this literature reviewed show that students should

be well equipped with ICT literacy and competencies in school in order to fit into the rapidly revolutionizing digital world of technology. It is seen that the use of ICT in schools offer a great potential for producing effective students who will be able to fit into the 21st century technological advancement in their various workplaces.It has been revealed that students who are not technology inclined will begin to lose track of events. Kubiatko, Yilmaz and Halakova (2012) buttressed this point by pointing out that the continuous usage of computers influences the development of various computer based skills and techniques and improves one's knowledge of the computer entirely. The review also shows that the benefits of integrating ICT into education is immense as the use of ICT improves the quality of education, promotes speed and efficiency leading to increased productivity, develops the ability of critical thinking that will equip students with the skills and competencies which will enable them integrate fully into workplace.

Researches have also shown that the use of ICT improves learning and leads to better performance in Biology. Furthermore, the availability, usage and positive attitude towards ICT provides a platform for attaining ICT competency. However, most of the research works carried out on ICT competency were at international level. Also, the investigation was done using teachers, lecturers and university students. From the literature it has been established that the questionnaire can be used as the instrument for data collection to carry out the research. Dincer and Sahinkayasi (2011) focused on University students and used an open-ended and closed-ended questionnaire for data collection, and sample t-test and Pearson Product Moment Correlation for analysis. The study by Walcolt, Neale and

Depradine(2013) was among part-time students in tertiary institutions in Barbados. The t-test for independent samples and linear regression were used to analyse the research questions.

However, there is need to research into activities that will improve the level of ICT competency among biology students, which could lead to good academic performance in Biology and also prepare the individual for the workplace. The purpose of this study was to find out the effect of ICT on teaching and learning, and to investigate how availability of ICT facilities, usability of ICT facilities and positive attitude toward ICT can lead to ICT competency among biology students, and how it can equip them to be able to integrate to workplace, majority of which is now ICT compliant.

This study is unique when compared to other related studies carried out both within and outside Nigeria. Among its uniqueness is that the study was conducted in Federal Colleges of Education in Kano State and is restricted to biology students only. The study also examined gender difference, frequency in the use of ICT facilities and availability in relation to ICT competency. None of these reviewed literatures sought to find out ICT competencies among biology students in Federal Colleges of Education in Kano State. This study is therefore aimed to fill this gap in literature so as to come up with relevant information on such area in Kano State.

There is no evidence that this pattern has been utilized by any other researcher before.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods used by the researcher in carrying out the study. The following issues were specifically discussed: The research design, population of the study, sample size, sampling techniques, instrument for data collection, validity of the instrument, reliability of the instrument, data collection procedure and data analysis procedures.

3.2 Research Design

The research design that was used for this study was the descriptive survey design by use of questionnaire to seek the opinion, attitude and the idea of the respondents. According to Nworgu (2006) Research Design is the study that aims at collecting data of a population and describing the data collected in a systematic manner. Furthermore, Bichi, (2004) stated that descriptive research is a situation where the investigator collects data on two or more variables, and analyse them statistically to assess the type of relationship that exist between them. Therefore, this research design was chosen since this study involved the collection of data from a population and described the data collected in a systematic manner. The descriptive survey research design is appropriate for this study, since it was useful in studying a variety of problems involving data for answering research questions and also permitted the description of the conditions as regard assessing ICT competency among Biology students of Federal Colleges of Education in Kano State of Nigeria. This study aimed at describing the current nature of the ICT competency level of Biology students, the availability of ICT

facilities and the frequency in the use of these facilities among the Biology students of Federal Colleges of Education in Kano State.

3.3 Population and Sample Size of the Study

Population of this study described the entire body that constitutes the research subject. The population according to Bichi, (2004) does not involve everybody, but everybody falling into the category whose characteristics is being studied. The population of this study comprises the two Federal Colleges of Education in Kano State. The respondents are the Biology students of the Federal Colleges of Education in Kano State.

3.3.1 Population of the Study

The population of this study comprises all the Biology students of the Federal Colleges of Education in Kano State, Nigeria. There are two Federal Colleges of Education in Kano State, and they are: Federal College of Education Kano and Federal College of Education (Technical) Bichi. According to the information gathered from the Exam Officers and Heads of Departments of the schools, there are 1036 (One thousand and thirty six) Biology students in FCE Kano, while there are 1367 (One thousand three hundred and sixty seven) Biology students in FCE(T) Bichi, making a grand total of 2403 Biology students at different levels in the Federal Colleges of Education in Kano State.

Table 3.1 below presents the population of the biology students in the Federal Colleges of Education in Kano State.

Table 3.1: Population for Biology students

S/N	COLLEGE	LEVEL	POPULATION
1	FCE KANO	NCE 1	380
		NCE11	374
		NCE111	282
2	FCE(T) BICHI	NCE1	344
		NCE11	629
		NCE111	394
	TOTAL		**2403**

Source: FCE Kano and Bichi, 2016

Table 3.1 shows that there are three hundred and eighty (380) Biology students in FCE Kano in NCE1, three hundred and seventy four (374) in NCE11 and two hundred and eighty two (282) in NCE111, which amount to a total number of one thousand and thirty six (1036), while the population of Biology students of FCE (T) Bichi in NCE1 are three hundred and fourty four (344), six hundred and twenty nine (629) in NCE11 and three hundred and ninety four (394) in NCE111, making a total of one thousand three hundred and sixty seven (1367) biology students, which sums up to a total number of two thousand, four hundred and three (2403) biology students in the federal colleges of education in Kano state.

3.3.2 Sample Size

Sample used for this study comprises 331 Students. The students were randomly selected from the area of study/population and the sample

was systematically selected using Kraijcie and Morgan table for determining population and sample size.

The table below represents the sample of the population of Biology students of the Federal Colleges of Education in Kano State.

Table 3.2: sample of Biology students

S/N	COLLEGES	POPULATION	SAMPLE	MALE	FEMALE
1.	FCE Kano	1036	143	44	99
2.	FCE (T) Bichi	1367	188	143	45
	TOTAL	**2403**	**331**	**187**	**144**

Table 3.2 indicates that there are one thousand and thirty six (1036) Biology students in FCE Kano with a sample of one hundred and fourty three (143), with a total of 44 male students and 99 female students, and one thousand three hundred and sixty seven (1367) Biology students in FCE(T) Bichi having a sample size of one hundred and eighty eight (188), with a total of 143 male students and 45 female students, making a total sample of three hundred and thirty one (331) Biology students in the colleges.

3.3.3 Sampling Technique

The sampling techniques that were employed are the stratified simple random sampling as there are different levels among the respondents. In selecting the respondents randomly without bias, the Random Number Table was used where the respondents were assigned identification number in relation to the table numbers.

3.4 Data Collection Instrument

A Check-list, used to determine the availability of ICT facilities in the colleges and a questionnaire adapted from ICT Familiarity Component for the Student Questionnaire PISA (2009) and MASTER-EN (student questionnaire vocational upper secondary education (grade 11) were used for data collection. The questionnaire named ICT Competency Questionnaire (ICTCQ) consists of two sections. The first section focuses on Bio data of respondents, while the second section is a likert-type questionnaire of two parts containing thirty two(32) items. The first part contains 16 items on Frequency in the use of ICT and is rated on a 3 point rating scale thus:

Not Used (NU) 1.00

Rarely Used (RU) 2.00

Frequently Used (FU) 3.00

The second item on Level of ICT competency is also rated on a three point rating scale thus:

Not Competent (NC) 1.00

Fairly Competent (FC) 2.00

Highly Competent. (HC) 3.00

3.5 Validity and Reliability of the Instrument

In order to ensure that the instrument measure what they are supposed to measure, the instrument was subjected to validity and reliability testing.

3.5.1 Validity of the Instrument

In an attempt to ensure the validity of the instrument, it was given to three specialists from English Department and Science and Technology Education Department, including the supervisor who were expected to rate the instrument and examine the content of the instrument for coverage, clarity and ambiguity, and also to check if it agrees with the research questions, statement of the problem as well as various literatures reviewed. The specialist from English Department corrected the grammatical errors in the instrument, the specialists in test and measurement from the Department of Science and Technology Education examined if the content was satisfactory and measures what it is supposed to measure, while the supervisor further did a face validation making vital corrections where necessary to make the instrument standard enough to administer, thenthe researcher effected the necessary corrections made on the questionnaire.

3.5.2 Reliability of the Instrument

To ascertain the reliability of the questionnaire, a pilot test was conducted using 10 students from a State College of Education in Kano State. A test-retest technique was employed where an interval of two weeks was given in order to determine the reliability of the instrument using the Pearson Product Moment Correlation Co-efficient (PPMC).The reliability index was computed as r = 0.816 at 0.05 level of significance, showing that the instrument is reliable and suitable for administration.

3.6 Data Collection Procedure

The researcher collected an introductory letter from the Head of Department Science and Technology Education Bayero University Kano which was presented to the management of the Federal Colleges of Education Kano stating the purpose for the researchers' visit. A research assistant from the college was given to the researcher to assist in the administration and collection of the instrument. The Head of Department also assisted by taking the researcher and research assistant to the lecture hall where the biology students were having their general class, introducing them to the lecturer and students in the lecture hall and telling them the purpose for the visit. The questionnaire was administered to the respondents with the assistance of the research assistant, and the respondents were told to study it critically, carefully fill it and return it by their next meeting which was the next week. The research assistant went for the collection of the instrument which was conveyed to the researcher as well.

The researcher also visited the department with a checklist to check the availability of ICT facilities listed in the checklist.

3.7 Data Analysis Procedure

The data wasanalysed using descriptive statistics (percentage, mean and Standard Deviation) and inferential statistics using Chi-square, Analysis of Variance (ANOVA) and Scheffe's test) at 0.05 level of significance. The percentage was used to analyse the first research question which is on availability of ICT facilities, while the mean and standard deviation were used to analyse the frequency in the use of ICT and level of competency in ICT (i.e. the second and third research questions). The Chi-square, ANOVA and

Scheffe's test were used to assess the relationship between variables as it was used to treat the hypotheses. The Chi-square was used to test the hypotheses that there is no significant gender difference in ICT competency, and there is no significant difference between FCE Kano and FCE(T) Bichi in their level of ICT competency. The ANOVA was used to test the hypotheses that there is no significant difference between NCEI, NCEII and NCEIII in their level of ICT competency, while the Scheffe's test was used to locate where the actual difference between NCEI, NCEII & NCEIII lies.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents and describes the results obtained from the study. This is carried out according to the research questions contained in the questionnaire which served as a guide to the study.Three hundred and thirty one (331) copies of the questionnaires were distributed; the whole of the questionnaire representing 100% were filled and returned by the respondents from the two Colleges of Education under study. The research questions were analysed using percentages (%), mean (X) and Standard Deviation (S.D). Chi-square, ANOVA andScheffe's test were used to analyse the hypothesis and presented in tables.

4.2 Data Presentation

Data collected was analysed and presented below based on the research questions and hypotheses

Research questions 1: To what extent is ICT resources available for use?

Table 4.1: Availability of ICT Resources

S/N	Item	Available		Not Available		Remark
		F	%	F	%	
1	ICT centre in the college	2	100	0	0	Available
2	Desktop computers	2	100	0	0	Available
3	Internet Connection	1	50	1	50	Available
4	Scanner	2	100	0	0	Available
5	Printer	2	100	0	0	Available
6	Television	0	0	2	100	Not Available
7	DVD Player	0	0	2	100	Not Available
8	Overhead Projector	2	100	0	0	Available
9	Interactive White Board	2	100	0	0	Available
10	Digital Camera	2	100	0	0	Available

Table 4.1 above revealed that items 1, 2, 3, 4,5,8,9 and 10 are available whereas, items 6 and 7 are not available. This indicate that the department through the ICT centre in the College have facilities/resources, for effective teaching of Biology, however, the facilities available could no longer match with the adequate number of students in the department.

Research Questions 2: How frequently do the Biology students in Federal Colleges of Education in Kano State use ICT resources?

Table 4. 2: Responses on frequency in the use of ICT resources by Biology students of Federal Colleges of Education, Kano.

The decision rule is 2.00, where a mean of $\bar{x} > 2.00$ is accepted as frequently used where a mean $\bar{x} < 2.00$ indicating not used or rarely used.

S/N	ITEMS	NU	RU	FU	Mean	Decision
11.	Use of word processor for creating document	62	156	113	2.15	Freq. used
12.	Use of power point packages for creating slides for presentation	96	150	85	1.97	Rarely used Or not used
13.	Use of graphic software such as photo-shop and CorelDraw	97	136	98	2.00	Freq. used
14.	Use of data-based processing software(spreadsheet) such as MS Excel	77	157	97	2.06	Freq. used
15.	Use of storage devices such as flash,CD,DVD, for data storage	72	139	120	2.15	Freq. used
16.	Use of statistical packages for data processing	96	154	81	1.95	Rarely used Or not used
17	Use of internet in conducting research	69	143	119	2.15	Freq. used
18	Sending and receiving mails	69	150	112	2.13	Freq. used
19	Online video streaming	122	127	82	1.88	Rarely used Or not used
20.	E-conference	129	124	78	1.85	Rarely used

						Or not used
21.	Downloading and uploading data/ photos and/or information to the internet	71	144	116	2.14	Freq. used
22.	Using social network for students/ academics	57	163	111	2.16	Freq. used
23.	Surfing or browsing sites such as the college websites	60	142	131	2.23	Freq. used
24.	Installing software on your computer	70	160	101	2.09	Freq. used
25.	Registering and participating in online training programmes	82	137	112	2.09	Freq. used
26.	Posting your profile or CV on Job websites	119	121	91	1.92	Rarely used Or not used

Table 4.2 above revealed that biology students are browsing from the college websites, used word processor for creating document, and the storage facilities such as CD, DVD and rarely or not used PowerPoint for presentation as well as E- conferencing via internet.

Research questions 3: What are the differences among the Biology students in terms of gender, level and between the colleges in their level of ICT competency?

Table 4.3: ICT Competency means rating differences between male and female biology students of both Federal Colleges of Education.

Gender	N	Mean	Std. Dev.	Decision
Male	187	71.18	17.39	Competent
Female	144	68.96	15.77	Competent

Table 4.3 revealed that male and female Biology students of both Federal Colleges of Education, in Kano have the following mean ICT competent rating of 71.18 and 68.96 respectively. This indicates that the male students are slightly more competent than their female counterpart on the use and ICT competency level.

Table 4.4: ICT Competency means rating differences between NCEI, NCEII and NCEIII biology students of both Federal Colleges of Education.

Level	N	Mean	Std. Dev.
NCEI	99	70.6	17.39
NCEII	138	65.25	15.77
NCEIII	94	74.97	14.36
Total	331	69.93	16.59

Table 4.4 showed that the ICT competency mean ratings of NCEI,NCEII and NCEIII levels Biology students of both Federal Colleges of Education Kano are 70.60,65.25 and 74.97 respectively. This indicates that NCEIII biology students are more competent in terms of ICT with mean of 74.97; followed by NCE I with a mean of 70.60 and then NCEII students with a mean of 65.25. Therefore, the distribution is usually centred, indicating competency levels are closely related.

Table 4.5 ICT Competency means rating differences between both Federal Colleges of Education in Kano.

School	N	Mean	Std. Dev.
FCE Kano	143	73.00	17.09
FCE(T) Bichi	188	66.85	15.19

Table 4.5 clearly showed that ICT competency mean rating between FCE Kano biology students and FCE (T) Bichi are 73.00 and 66.85 respectively. This indicated that both students of these Federal colleges of Education are competent in the use of ICT indicating that they are closely centred around a particular point

4.3 Hypotheses Testing

HO_1: There is no significant gender difference among the biology students in Federal College of Education in Kano State in their level of ICT Competency.

Table 4.6: Chi-Square Tests for the differences in ICT competency across gender

	Value	Df	p-value
Pearson Chi-Square	12.538[a]	1	.512
Likelihood Ratio	12.804	1	.624
Linear-by-Linear Association	12.450	1	.534
N of Valid Cases	331		

From the chi-square test in table 4.6 above the p value is greater than 0.05 level set for testing the hypothesis. Therefore, the null hypothesis is not rejected. That means there is a no significant difference in the level of ICT competency between male and female students.

HO_2: There is no significant difference in ICT competency among NCEI, NCEII & NCEIII Biology students in Federal Colleges of Education in Kano State in the level of ICT competency.

Table 4.7: ICT Competency among NCE I,NCE II & NCE III Biology students in Federal Colleges of Education in Kano

	Sum of Squares	**Df**	**Mean Square**	**F**	**p-value**	**Decision**
Between Groups	1577.134	2	1588.567	6.2925		Significant
Within Groups	32157.546	329	243.264		0.0285	
Total	23531.750	331				

From table 4.7 above, there is significant difference in the ICT competency mean rating among NCEI,NCEII and NCE III biology students of FCE Kano .From the table p-value(0.0285) is less than the significant level (0.05) at which the hypothesis was tested. It therefore shows that there is significant difference in the ICT competency mean rating among the three groups. Thus the null hypothesis was rejected.

Table4.8: Scheffe Post hoc on Mean ICT Competency Rating among NCEI, NCEII and NCEIII Biology Students of both Federal Colleges of Education in Kano.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	p-value
NCEI	NCEII	5.85172*	1.7642	0.001
NCEI	NCEIII	-4.6543	2.7652	0.008
NCEII	NCEIII	-9.643	2.641	0.002

Post hoc analysis using Scheffe test further confirms that a significant difference exists between NCE I and NCEII ($p=0.001 < 0.05$) and NCEII and NCEIII ($p=0.002 < 0.05$) but there is no significant difference between NCEI and NCEIII ($p=0.08 > 0.05$).

HO_3: There is no significant difference in the level of ICT Competency between the Biology students of Federal College of Education, Kano and Federal College of Education (Technical), Bichi.

Table 4.9: Chi-square statistical test of responses of ICT competency among biology students of Federal College of Education, Kano and Federal College of Education (Technical), Bichi

	Value	Df	p-value
Pearson Chi-Square	20.297[a]	1	3.302
Likelihood Ratio	19.961	1	3.402
Linear-by-Linear Association	20.340	1	2.300
N of Valid Cases	331		

From the chi-square test above the p value (3.302) is greater than 0.05 level set for testing the hypothesis. Therefore, the null hypothesis is hereby not rejected. That means there is no significant difference in the level of ICT competency between both Federal Colleges of Education, Kano.

4.4 Summary of Findings

From the result presented in this study, the summary of the research findings are:

1. There are ICT resources available for use in both Federal Colleges of Education in Kano.
2. The biology students of both Federal Colleges of Education frequently use most of the ICT facilities available.

3. There is no significant gender difference among the Biology students of both FCE Kano and FCE (T) Bichi in their ICT competency level.
4. There is a significant difference in the level of ICT competency between NCEI,NCEII and NCEIII students of Federal college of Education, Kano. The Scheffe test indicates that the difference is located between the NCEI and NCE II biology students.
5. There is no significant difference betweenBiology students of both Federal Colleges of Educationin their competency in the ICT activities considered in this study.

4.5 Discussion of the Results

This study assessed Information and Communication Technology competency in relation to its availability and utilization among Biology students in the Federal Colleges of Education in Kano State. The study also investigated gender influence on students' ICT competency level. Three research questions were answered and three hypotheses were tested. The analysis of the data obtained were presented in tables in accordance with the stated research questions and hypotheses. The findings from the analysis are discussed below:

The result of this study in table 4.1 showed that there are available ICT resources in both Federal Colleges of Education in Kano State. The study of Tella (2011) is inconsistent with the findings of this study. His study investigated the level of Availability and Utilization of ICT facilities among students in some South-western Nigeria Colleges of Education. The result obtained revealed that availability of ICT facilities is low.

The result of this study from table 4.2 indicated that the biology students of the Federal colleges of Education in Kano frequentlyuse the available ICT resources. This finding is not in consonant with theinvestigation conducted by Adeosun (2010) when he highlighted that although efforts have been made to ensure that ICT resources are available and used in Nigerian schools, the level of utilization is still low.The study of Adedeji (2011), also do not agree with the findings of this study in which he investigated the level of availability and utilization of ICT facilities among students in some south-western Nigeria Colleges of Education. The findings of the study revealed that the level of ICT facilities utilization is poor.

The results of this study revealed that the male biology students of the Federal Colleges of Education have higher ICT competency mean rating than the female students, although with a slight difference in the mean score. This coincides with the research conducted by Hew and Leong (2011) on "An Empirical Analysis of Malaysian Pre-University Students' ICT Competency Gender Differences''. The findings indicated that statistically both genders do not have significant gender difference in eight out of nine ICT Competencies, the male students still have a slightly higher mean score in all the ICT competencies except the word processing competency, where the female have a higher mean score. This is contrary to the investigation of Wong and Cheung (2013) in investigating Gender Differences in ICT Competency for University students of Different Disciplines. The result revealed that females' scores were higher than males' scores on five assessment components out of seven with statistical significance. Therefore, the findings are in contrast with the

widespread belief that male students usually perform better in ICT courses than their female counterparts.

The outcome of the study showed that there is no significant gender difference among the biology students of both FCE Kano and FCE (T) Bichi in their ICT competency level.The result revealed that there is no significant difference in the ICT competency mean rating between male and female biology students of FCE, Kano. The p-value was found to be .512 at $P \leq 0.05$. Hence, the null hypothesis is not rejected. This is similar to the study of Anunobi (2014), where she investigated the information and communication technology literacy level among student-teachers in universities in north central Nigeria, as well as the influence of gender/areas of specialization on the student-teachers level of ICT literacy. The result of the study showed that there was no significant difference established in the level of ICT literacy between male and female student-teachers. On the contrary the study of Ofoegbu (2013) investigating Information and Communication Technology competencies of lower and middle basic science and technology teachers in Enugu State stated that there is no significant difference in the mean ratings of the ICT competencies of male and female technology teachers. The result indicated that there is significant difference between male and female respondents.

The result of the study showed that there is significant difference in the ICT competency rating among NCEI, NCEII and NCEIII levels biology students of FCE in Kano State. Specifically, the difference lies between NCEI and NCEII biology students. The NCEIII biology students of the Federal colleges of Education were of a higher ICT competency level than the NCEII and NCEI level students. This could be due to the fact that the NCE III students could be more experienced as a result of spending longer time in the system than the NCE 200 and

NCE100 level students. The reason for the 100 level students being more competent than the 200 level students could be due to the fact that most secondary school students go for computer training after their WAEC during the period of waiting for their admission, and this could attribute to their higher competency level in ICT, or it could also be as a result of the newly invented CBT (Computer Based Test) carried out by students during their JAMB (Joint Admission and Matriculation Board) Exams, in preparation for the tertiary institutions. This system exposes them to the use of some ICT facilities and packages which they can carry along as they enter into the Colleges of Education and other higher institutions.

In comparing the two colleges of education in their level of ICT competency, the result of the study in table 4.9 show that there is no significance difference in the ICT competency level between biology students of FCE Kano and FCE (T)Bichi.This is in consonance with the study of Dincer andSahinkayasi(2011) where they sought to examine a cross-cultural study of ICT competency, attitude and satisfaction among students studying at universities in Turkey, Poland and Czech Republic.Findings of the study showed that although Turkish students began to use computer and internet later than Polish and Czech students, no difference was seen between them regarding their computer competency.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter highlights the summary of the study, conclusions drawn from the findings and recommendations made from the study, and recommendation for further studies.

5.1 Summary

This study assesses Information and Communication Technology competency among biology students in Federal Colleges of Education in Kano State. The study also investigated the availability and utilization of ICT facilities and its effect on students' performance in Biology.

To direct this research, three research questions were answered and three null hypotheses were tested. Several literatures related to this study and important contributions done by some authors have been critically reviewed and analysed. It was discovered that the use of ICT in biologyteaching is very essential at it makes learning of difficult and abstract topics interesting and easy to understand, thereby leading to better performance in biology. Also, the use of ICT facilities increases the students' ability to manipulate various hardware and software which will increase their level of ICT competency.

The target population for the study was 2403 biology students. A sample of 331 biology students were randomly selected from the two Federal Colleges of Education in Kano State. The check list and questionnaire served as the instruments for data collection and was validated by specialists in test and measurement from the Department of Sciences and Technology

Educationin BayeroUniversity, as well as the supervisor for both face and content validation.

The data obtained from the respondents were subjected to statistical analysis at 0.05 level of significance using SPSS 20, percentages, mean and standard deviation to answer the research questions and Chi-square, Analysis of Variance (ANOVA) and Scheffe post hoc tests were usedto test the hypotheses on ICT competency in relation to gender, level and school.

The result of the study was presented in tables according to the research questions and hypotheses to which they relate. The major findings include:

1. There are ICT resources available for use in both Federal Colleges of Education in Kano.
2. The biology students of both Federal Colleges of Education frequently use most of the ICT facilities available.
3. There is no significant gender difference among the Biology students of both FCE Kano and FCE (T) Bichi in their ICT competency level.
4. There is a significant difference in the level of ICT competency between NCEI,NCEII and NCEIII students of Federal college of Education, Kano. The Scheffe test indicates that the difference is located between the NCEI and NCE II biology students.
5. There is no significant difference betweenBiology students of both Federal Colleges of Educationin their competency in the ICT activities considered in this study.

5.2 Conclusions

Based on the findings from this study the following conclusions have been drawn:

1. ICT facilities are available in the Federal Colleges of Education in Kano State and havean important placing as an instrument for effective pedagogy and national development. This indicates that the students are carried along in the continuous improving technological era and this should affect their level of ICT competency positively.
2. The biology students in the Federal Colleges of Education in Kano State frequently use most of the ICT facilities, although they do not use some of them.The study revealed high level of ICT competency among biology students which implies that they have access to ICT facilities and utilize them, and with more efficiency in the use of ICT facilities, there will be higher degree of competency among biology students in Federal Colleges of Education.
3. The male students are slightly more competent than their female counterparts. This implies that female are inclined, and this is narrowing the gap between male and female in the use of ICT facilities.
4. The 300 level students of the colleges of Education show a higher competency level in ICT than those in level 200 and level 100. This implies that the number of years spent in the college could help students' competency level as they may have had more opportunities to be exposed to ICT related activities.

5. The study also shows that the biology students of FCE Kano are slightly more competentin ICT than the biology students of FCE(T) Bichi. This indicates that both Colleges have positive attitudes towards the use of ICT facilities.

5.3 contribution to Knowledge

This study is very significant and essential because it has contributed to knowledge in the following ways:

1. The study reveals the level of the availability of ICT facilities in the Federal Colleges of Education in Kano State, and the extent to which the facilities are being used by the Biology students for their educational activities, and it is an established fact that ICT facilities are available in the colleges, and are also used by the biology students thereby bringing about competency in the use of ICT facilities among the students.
2. The study has also established that females currently exhibit ICT skills proficiency which has narrowed the gap between male and female in ICT competency. This is an indication that the females are now being ICT inclined.

5.4 Limitation of the study

In the course of carrying out this study, the following setbacks were observed by the researcher:

1. The samples used for the study were limited to only Federal Colleges of Education in Kano State. Other state and private Colleges of Education

were not involved. The inclusion of these schools may affect the findings of this study. Hence, it limits generalization of findings.

2. In the study, only biology students of the Federal Colleges of Education were used which therefore limits the scope of generalization.

5.5 Recommendations

5.5.1 From the Study

The following recommendations are proffered on the basis of this study:

1. Students should be given assignments and group works that require them to source for information from the internet, as this will expose them to the use of diverse ICT facilities, thereby increasing their ICT competency level.
2. It is recommended that curriculum planners and stakeholders in education sectors should design programs and policies that will incorporate the maximum use of ICT in teaching and learning of biology in Federal Colleges of Education.
3. The lecturers should make use of more interactive approaches by using projectors, computers and power point slides for teaching biology. Students should also be given presentations to make using these facilities.
4. Federal Colleges of Education should be equipped with various ICT facilities for the utilization of both staffs and students. It is the best place for ICT facilities to be provided as it is a training ground for future teachers and stakeholders, as this knowledge and

competencies obtained can be used to plan befitting educational programs that will benefit the educational sector, and will produce individuals that possess ICT skills and competence which can be transferred to others through instruction to enhance the teaching and learning process and also promote understanding of abstract concepts in Biology.

5.5.2 For further Studies

The following recommendations have been made for further studies:

1. The present study was limited to ICT competency level of biology students and Federal Collegesstudents in the Federal Colleges of Education in Kano State. It is therefore recommended that similar studies be conducted in other states of the federation, to see if it will yield similar or different results with the present study.
2. There is a need to conduct similar study in universities, polytechnics, and secondary schools.
3. It is recommended that the study be followed up every 4-5 years so as to update the government, educational stakeholders and colleges of education on the level of ICT competency of their students.

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