EFFECTS OF ELECTRONIC AND PRINTED COURSEWARE ON BIOLOGY STUDENTS' ACHIEVEMENT, ATTITUDE AND RETENTION IN GENETICS IN COLLEGES OF EDUCATION IN NIGER STATE

BY

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JUNE, 2021

ABSTRACT

This study was carried out to compare the effects of electronic courseware and printed book on Biology students' achievement, attitude and retention in Genetics in Colleges of Education in Niger State. The influence of gender was also examined. The study adopted a quasi-experimental research design which involved two levels of independent variables (printed book and electronic courseware), three levels of dependent variables (achievement, retention and attitude) and one moderating variable (gender). Seven research questions and seven corresponding null hypotheses guided the study. The sample of the study consist of 120 year two Biology students selected through a multistage sampling techniques from two Colleges of Education within the study area. First, simple random sampling technique was used to select students of NCE 2 in the two Colleges of Education (FCE Kontangora and C.O.E. Minna) through paper ballotingThereafter, the two Colleges were assigned to Experimental (Ebook) and Control Group (Printed book). Thereafter, intact classes of NCE 2 students in the two Colleges were used for the study. Five research instruments was used in this study. They are: Printed Book of Genetics Concept (PBGC), Electronic Courseware on Genetics Concept (ECGC), Genetics Achievement Test (GAT), Genetics Retention Test (GRT) and Attitude Questionnaire towards Genetics. The PBGC is a 30-page well-structured lesson note on Genetics concepts printed in coloured form on paper while the ECGC is the electronic version of the PBGC. Both appear in colour form but instead of diagrams and pictures in the printed version, the electronic version has short video clips and animations to meet the standard features of an ebook. The GAT is a 40-item multiplechoice objective questions with five options (A-E), out of which there was only one correct answer which attracts two and half marks each to make a total of 100Marks. These instruments were validated by experts from Educational Technology Department, Science Education and Biological Science Departments all from Federal University of Technology Minna, Niger State. The validity of GAT was ascertained using Kuder-Richardson-20 formula and a coefficient of 0.82 was obtained. Also, the reliability for the attitudinal questionnaire was ascertained using Cronbach alpha reliability coefficient and a coefficient of 0.74 was obtained. This indicates that the instruments were reliable. Findings revealed that electronic courseware significantly improved Biology students' achievement in Genetics with the grand mean difference of 13.09 more than students taught with printed book. Also gender difference does not exist in students' achievement after exposure to the two types of book. Based on these findings, it was recommended that instructional contents should be disseminated to students in form of electronic courseware as these would attract, enhance their independent study and improve their academic achievement, attitude and retention.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Information and Communication Technology (ICT) is one of the most effective tools for improving knowledge and skills. The use of ICT in higher education enhances student-centred learning which makes it a necessity for quality education in Nigerian Tertiary institutions because it helps to accelerate learning process, increase teacher's efficiency and effectiveness thereby providing remedial instruction and enrichment of material, thus, guaranteeing higher quality standards in schools (Osakwe, 2012). The use of ICT in schools are known to provide positive change which enhances better academic performance. When ICTs are employed in education given the right condition, they can accelerate, enrich, and deepen basic skills in reading, writing, mathematics and sciences, and they can motivate and engage students to learn as they become more independent and responsible for their learning (Onodugo, 2015).

The introduction of ICT has impacted positively on science and technology which have made man comfortable having improved his thinking process and very importantly improved his health, technological development vis-à-vis biological growth and selfreliance (Yisa, 2014). However, a general review of Nigerian students' performances in science subjects particularly Biology has remained a source of concern to stakeholders in the education sector especially in the area of genetics. Genetics is one of the concepts studied in biology. According to Bridget (2016), the study of genetics can be intellectually fascinating, but it also has a lot of practical applications. From the use of DNA in court cases to the discovery of new therapies for genetic diseases, a thorough understanding of the human genome can have important medical, social and legal impacts. The rapid advances in genetic research, the popularity of the topic and the direct role of the concept play in human health and reproduction makes it a scientific discipline that everyone needs to understand. Yet, several studies revealed that students fail to critically understand the genetics contents taught in the classroom. This lack of understanding translates to an inability to apply basic knowledge of the concept to their everyday lives, (Maigoro *et al.*, 2017).

Many concepts in biology including genetics can be perceived as difficult to learn by students and this has negatively affected their performances. A study by Mbajiorgu et al. (2006) in Maigoro et al. (2017) revealed that science is a difficult subject to understand and grasp. Regardless of age, culture, and educational background, many students carry their own understanding of science, genetics is not an exception in this matter. Genetics is a very broad and complicated concept. Significant advances in genetics in recent decades have dramatically increased the impact of genetic information and technologies on society. Genetic issues now play a vital role in health and public policy (Kolsto, 2001). In spite of this increased exposure to genetics, recent studies of the general public's genetics knowledge show a relatively low understanding of genetics concepts, (Human Genetics Commission, 2001; Bates, 2005). Lewis and Kattmann, (2004) also stated that genetics is considered to be one of the most difficult concepts in biology and the mechanisms are hard to understand because it is difficult to make the ideas to be tangible without the help of special instruments. This is why Ezenwa (2005) opined that meaningful learning in science comes as an outcome of strategic medium that would maximize interaction between the learners themselves. The search for more effective medium for teaching science underscores the importance of learner- centeredness in the teaching- learning situation and it has led to focusing attention on the method and medium of effective teaching. Other researchers like Yisa (2005) and Nsofor (2010) stated that meaningful learning is the fundamental process

that under lines useful knowledge acquisition and construction. However, the method of lesson delivery is of uttermost important in teaching and learning at any level of educational system.

In the early centuries, teaching and learning at all levels of education occurred through the medium of textbooks but the introduction of computer and internet into the world of education has given new dimensions to educational process. With the emergence of electronic media, books, research periodicals, journals, magazines, news-papers and so many other reading materials were transformed into electronic text. The expenses of paper and allied materials used in the printing of books and other reading materials were considered wastage of materials, money and human energy, that is why in the United States of America, the purchase of e-books has surpassed the printed books and magazines today. E-reading materials in conjunction with printed reading materials into electronic format have not only increased the access opportunities throughout the world for readers, but also have reduced the expenses. There are evidences for the support of e-reading materials particularly in term of access, quality, beauty, effectiveness and learning for students (Korat &Shamir, 2008).

With the development of the means of electronic publishing, globalized information, and easy access via internet, electronic book became more advanced tool used to transfer knowledge (Chen, 2002). Electronic book is a type of portable digital information having shapes varied from compacted disc to interactive database on the internet or a group of web pages, or interactive pages containing electronic information displaying many of the characteristics of the electronic book, or learning environment with an application program containing a database with assistant media for educational resources. Usha (2006), defined electronic books as the container that has been transformed to digital form, and readable via personal computer or via a compacted disc

or portable device designed to achieve this purpose, and usually it can be exchanged and set available on the internet and through its services; electronic book is featured than printed media by adding multiple new specific features such as hypertext links, cross-references function and multimedia elements (Auradha *et al.*, 2006). Many studies have shown that there is improvement in learning when electronic books are used compared to printed books. For instance, Amari andShabel, (2012) confirmed the effectiveness of using electronic books in increasing the achievement of first-grade students of secondary school in reading course compared to printed books. Abdullah, (2011), also discovered the effectiveness electronic books in the development of creative thinking of science students. However, not all electronic books have a paper version, some electronic books are written as born-digital books, while thousands of existing print works have been digitized, and a small number are published in parallel with the printed books which are been used by students in Colleges of Education.

Colleges of Education encompassed the production of professional teachers who are equipped with skills and methodologies of teaching in our primary and junior secondary levels of education in Nigeria. Essentially, colleges of education are to provide full-time courses in teaching, instruction and training and to conduct courses in education for qualified teachers. In order to achieve this objective, academic quality assurance is required which can only be determined through the academic achievement of the preservice teachers (Sele, 2013).

Academic achievement can be defined as the outcome or an attainment at the end of academic endeavour (Olakunle, 2010). Uroko (2010) revealed that the academic achievement of a student is the result the student obtained at the end of an academic exercise. Academic achievement connotes attainment in a school subject as indicated by a score or marks on a test. Achievement of students in Biology in college of education

could be determined by their test scores. However, researchers have documented that students` achievement in Biology over the year have declined tremendously. Achievement is what somebody has succeeded in doing, especially after a lot of efforts. Achievement is the measurement of the effect of specific programme of instruction or training (Kulbir, 2005). In the context of this study, it refers to success in Biology especially in genetics indicating the amount of learning that has taken place when students are exposed to printed and electronic materials. Certain factors or variables can also promote students' achievement and retention in Biology in tertiary institutions.

Retention is regarded as student's capability to be able to remember and recall previously learnt concept. It is also viewed as keeping or holding something mentally. This is the ability to recall or remember things learned previously or to store information for long periods. Emmanuel, (2015), found that high academic achievement demands from the learners the following: ability to retain, intellectual capability, interest and discipline among others. Urebvu, (2013), observed that poor learning and retention in science may be related to the learner's inability to link new learning to previous knowledge. Maduabum (2015), reported that stimulating learning environment, and activity-oriented teaching strategies are major ingredients needed by learners to retain new learned information.

Many researchers in the past, conducted studies on retention with respect to school subjects. Some of the researched works are: Iji and Udoma, (2007) and Agiande, (2007) found out that students could retain concepts learnt in Genetics when taught with instructional strategies. This is because if a student achieved high in a post test and when a retention test comes, that student performs poorly, it is an indication that, the student did not register the concept in the long term memory. It is therefore necessary to search for a better strategy that will make students retain what they have learnt. The

persistent use of these strategies could make students active rather than passive learners and thereby promoting impactful learning and long-term retention of some abstract concepts in biology (Ahmed, 2008; Abimbola, 2011; Umar, 2011).

Modern psychological studies have shown that gender as a variable relates to achievement (Ezeugo et al., 2000). For instance, Thomas (2005), observed that boys choose science courses in high schools than girls especially mathematics, chemistry and physics. This is due to the long held view that women are weaker vessels who cannot stand the stress and strain involved in problem solving. However, Spencer (2004), Osemmwinyen (2009) and Iwendi, (2012), found no gender difference in the performance of male and female students in school mathematics. To this end, Ugwu (2018), argued that presently, female is struggling to fight the oppression, suppression and domination by their male counterparts. It may imply masculine and feminine roles are associated to males and females in the society. Gender and printed/electronic book can be seen as the relationship of gender to the effectiveness of printed and electronic books to facilitate the effectiveness of teaching and learning process (Chukwuemeka, Some studies have revealed that females have negative attitudes towards 2010). computer than the males (Chukwuemeka, 2010). Some revealed that females perform better than males. Some studies indicated that there was no gender influence on lecturers' attitude towards the use of ICT. Student attitudes are influenced by the quality and perceived ease of use of computer which relate to the level of student computer skills (Aixia and Wang, 2011). Gender in this study is inconclusive, it is on this wise that the researcher seeks to determine the effects of printed and electronic courseware on biology students' achievement, attitude and retention in genetics in Colleges of Education in Niger state.

1.2 Statement of the Research Problem

Today, technology has permeated every area of human sector, so also the medium of sharing knowledge and information has gradually shifted from customary to modern (Pempek *et al.*, 2008). As a result of available computer, internet, digital and mobile devices that support the use of social media, it is possible to chat online, send and receive files, depending on the social media platform being used, teachers in tertiary institution constitute a high percentage of individuals that subscribe to these social media platforms (Boyd *et al.*, 2007).

However, Biology curriculum in Colleges of Education over the years has been taught customarily, the only thing the students had access to is the notes given in class and handouts/textbooks making the whole process of gaining knowledge more teacher centred while the students rely on notes in class which invariably implies that the absence of the teacher means no access to knowledge. Achievement of students in Biology in college of education could be determined by their test scores. Hence, researchers have documented that students' achievement in Biology over the years have declined tremendously. Presently there are abundant printed and e-book materials that exist online for freein all fields of study, but lecturers in developing country like Nigeria, especially those in Niger State have not been using them. If lecturers are not using printed and electronic book, what effects does it have on Biology students' achievement in Genetics? Dinah, (2013) stated that, availability of text books, laboratory apparatus and other learning resources contribute significantly to the performance of students in Biology examination. Hence this study seeks to determine the effects of printed and electronic courseware on biology students' achievement, attitude and retention in genetics in Colleges of Education in Niger State.

1.3 Aim and Objectives of the Study

The aim of this study was to compare the effects of printed and electronic books on biology students' achievement, attitude and retention in genetics in Colleges of Education in Niger State. Specifically, the study was carried out to:

- find out the effects of electronic books (e-book) and printed book on Biology students' achievement in Genetics
- examine the influence of gender on Biology students' achievement in Genetics when exposed to electronic books
- examine the influence of gender on Biology students' achievement in Genetics when exposed to printed books
- determine the effects of electronic book (e-book) and printed books on Biology students' retention in Genetics
- examine the influence of gender on Biology students' retention in Genetics when exposed to electronic books.
- examine the influence of gender on Biology students' retention in Genetics when exposed to printed books.
- determine the effects of electronic books (e-book) and printed book on Biology students' attitude towards Genetics.

1.4 Research Questions

This study was guided by the following research questions;

1. What is the difference in the mean achievement scores of Biology students exposed to electronic and printed books on Genetics concepts?

- 2. How does gender have influence on the mean achievement scores of Biology students exposed to electronic book on Genetics concepts?
- 3. How does gender have influence on the mean achievement scores of Biology students exposed to printed book on Genetics concepts?
- 4. What is the difference in the mean retention scores of Biology students exposed to electronic and printed books on Genetics concepts?
- 5. How does gender have influence on the mean retention scores of Biology students exposed to electronic book on Genetics concepts?
- 6. How does gender have influence on the mean retention scores of Biology students exposed to printed book on Genetics concepts?
- 7. What is the mean attitude scores of students towards Biology when exposed to electronic and printed books on Genetics concepts?

1.5 Research Hypotheses

The following null hypotheses were tested in this study;

- H₀₁: There is no significant difference in the mean achievement scores of Biology students exposed to electronic and printed books on Genetics concepts?
- H_{0.2}: There is no significant difference in the mean achievement scores of male and female Biology students exposed to electronic book on Genetics concepts
- $H_{O 3}$: There is no significant difference in the mean achievement scores of male and female Biology students exposed to printed book on Genetics concepts

H_{0.4}: There is no significant difference in the mean retention scores of Biology students exposed to electronic and printed books on Genetics concepts?

- H_{0.5}: There is no significant difference in the mean achievement scores of male and female Biology students exposed to electronic book on Genetics concepts
- $H_{0.6}$: There is no significant difference in the mean achievement scores of male and female Biology students exposed to printed book on Genetics concepts.
- H₀₇: There is no significant difference in the mean attitude scores of students towards Biology after exposure to electronic and printed books.

1.6 Scope of the Study

The scope of this study was limited to the comparative effects of printed and electronic books on biology students' achievement, attitude and retention in genetics in Colleges of Education in Niger state. The sample scope is limited to students studying Biology Education in Colleges of Education within Niger state. Niger State College of Education Minna, and Federal College of Education, Kontogora, Niger State Nigeria are the only Colleges of Education in the state, hence these institutions were used for the study.

The study was conducted in six weeks and the Biology contents were limited to Genetics only. The choice of Genetics as a concept is due to its importance in the foundational knowledge of biology and the abstract nature of the content. The contents of the concept were sourced from widely used and recommended biology textbooks for Colleges of Education and other useful materials available. The independent variables that were manipulated in the study are print and electronic books. The moderating variable that was considered is gender. The dependent variables which were observed in the study are achievement, retention and attitude. The instruments that were used for data collection are Genetic Achievement Test (GAT), Genetics Retention Test (GRT) and Attitude Questionnaire towards Genetics (AQG).

1.7 Significance of the Study

It is expected that the findings from this study would be of benefits to government because it could provide them with the information they need to provide fund to ensure the sustainability of e-books implementation for learning. Findings from this study could be beneficial to researchers as it would provide them with the information that can serve as framework while researching deeply into other factors relevant to the use and impact of electronic books.

The result of this study will also help curriculum planners to design a package curriculum that enhance the use of electronic book in our educational resource centre. The findings from this study would help educational administrators to create awareness and encourage the use of electronic book which would go a long way to motivate both lecturers and students to maximize its effectiveness in teaching and learning process.

The findings of this study would help lecturers, instructors and teachers to be aware of the effectiveness of e-books and also prompt them to maximize its use which could make them to be more effective and efficient in the teaching process to either present their lessons/lecture notes or give assignments to students. This study will also be useful to lecturers on either making their course contents on printed book or online for effective teaching and learning process and it will encourage them to produce more qualitative materials to avoid criticism from colleagues and students because it will be available under the exploring eyes of all, thereby help in improving their professional skills.

This study would also be important to the students so they can keep their class materials organized digitally that can be easily accessed by using any electronic device. E-book

accommodate more learning styles for learners. Besides this, students can bookmark important pages or chapters and take notes as they do in traditional books. It will also provide information relevant to the use of electronic books. It would enlighten them on the benefits, impact and limitations on the use of e-book. Through this, students can be in charge of their learning material and can access their course materials anytime they want and source for materials for a life-long education.

In conclusion, the results of this research may also serve as a guide that could prompt government, Non-Governmental organizations to policy makers such as Joint Consultative Council on Education (JCCE), National Council on Education (NCE), National Commission for Colleges of Education (NCCE) and National University Commission (NUC) and other relevant stakeholders in the field of education to emphasize the use of e-books in all tertiary institutions during organized seminars, workshops and conferences.

1.8 Operational Definition of Terms

- Achievement: Students' mean scores after been exposed to print books and electronic books on genetics concept.
- Attitude: Students' belief and disposition towards Genetics through printed and electronic books.
- **Courseware**; is a designed course software containing genetics concept (Heredity) and instructions for learners
- **E-books:** An electronic version of books (biology) which can be read on a computer or specific designed-handheld electronic device.

- **Genetics:** is the study of heredity and heredity is a biological process where a parent passes certain genes onto their children or offspring.
- **Printed book:** is a version of biology book that does not require any electronic device in reading it.
- **Retention**: is the ability of students to repeat or recall learnt concepts in Genetics after a period of time.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Concept of information and communication technology (ICT) in education

The emergence of ICT can be considered as a major breakthrough in education because of so many reasons; Innovative information and communication technologies have significantly increased the rapidity of production, use and circulation of knowledge, thus making a country's economic and social welfare dependent on how quickly it can adjust its capacity to share and generate knowledge (Sam *et al.*, 2002). The changes from traditional print books to electronic books offer many potential opportunities for both developed and developing countries (Mulder, 2008).

The use of Information and Communication Technology (ICT) has become a necessity tool for enhancing students' learning, teachers' instruction, and as a catalyst for improving access to quality education in formal and non-formal settings (Yusuf and Balogun, 2011). It involves the use of computing and telecommunication media to provide easy and fast electronic storage, processing and transferring of information (Peter *et al.*, 2012). ICT can be seen as an instructional resource which covers a wide range of technologies which includes computers, telephones, machines, video and audio recorders, television etc. Other technologies as well that can increase the process of finding, analysing, documenting, exchanging and presenting of instructional based information (Akodolu, 2008).

ICT is a possible strategy for creating balance for developing countries as the new communication technology promise to reduce the sense of isolation by widening the range of opportunities to populations in rural areas which have inadequate schools, cater for women facing cultural and social barriers that limit their access to educational institutions, socially disadvantaged groups that includes minorities and students with disabilities (Kiilu and Muema, 2012). ICT facilitates access to resource persons such as mentors, researchers, professionals and experts worldwide. The accessibility both in terms of quality in areas of usefulness of information obtainable and quantity, in terms of availability of devices and internet network access, can therefore be important for effective and efficient usefulness of the system.

ICT in all forms are making dynamic changes to the society. They are influencing all aspects of life, the influences are felt more and more at schools because ICT provides both students and teachers with more opportunities in adapting learning and teaching to individual needs. Tinto (2002), stated that the potentials of ICT are increasing access and improving relevance and quality of education in developing countries. Tinio further states that ICT greatly facilitate the acquisition and absorption of knowledge, propose developing countries extraordinary opportunities to enhance educational goals. In Watson's (2001) description, ICTs have revolutionized the way people work today and are now transforming education systems. As a result, if school train children in yesterday's skills and technologies they may not be effective and fit in tomorrow's world. This is a sufficient reason for ICTs to win global recognition and attention. For instance, ICTs are reliable tools in facilitating the achievement of one of the Millennium Development Goals (MDGs), which is achievement of universal primary education by the year 2015.

Kofi Anan, the former United Nations Secretary General, points out that in order to attain the goal Universal Primary Education by the year 2015; we must ensure that information and communication technologies (ICTs) unlock the door of education systems. This indicates the growing demand and increasingly important place that (ICTs) could receive in education. Since ICTs provide greater opportunity for students and teachers to adjust learning and teaching to individual needs.

Furthermore, the use of ICTs in education also shifts the learning approaches. As put by Bransford, *et al.* (2005), there are constructive learning which sole responsibility of individual students is. This limits the role of the teacher to supporting, advising, and teaching students relatively than simply transmitting knowledge. The gradual progress in using computers changes from learning about computers, to learning computers, and finally to learning with computers (Volman, 2005).

2.1.2 Instructional materials for teaching and learning

Instructional resources are materials employed by the teachers to enhance the effectiveness of instruction, they are the information carriers specifically designed to elicit desired behavioural change in learners (Arokoyu and Ugonwa, 2012). They further explained that they include a wide variety of materials used for teaching and learning ranging from hardware to software. Teachers need to use a variety of teaching activities in their classrooms, which should include books whenever appropriate, and it can also serve as a means of reaching students of diverse backgrounds (Sianjina, 2000). He explained further that appropriate use of instructional resources in the classroom is to expand, enrich, implement, individualize, differentiate and extend the overall curriculum.

Instructional materials are the resource materials which help to facilitate teaching and learning. Instructional media are the channels of communication through which information is passed for usage in educational situation in conjunction with the instructor. Instructional media can be classified into three categories: (i) print media, (ii) non-print, and (iii) electronic media. The non-printed media are projected materials such as films, slides etc. while printed materials are books, text, map etc. and electronic media consists of visual, audio and audio-visual media that rely on electricity to function properly. All these and many more could stimulate a sense of observation in learners (Ganiyu, 2010).

Instructional materials can be classified into: Visual materials- such as picture, projectors, charts, real objects (realia) studies etc. these materials such as books, newspapers, journals, magazines, pamphlets, hand-outs etc. all appeal to the sense of seeing (Martins, 2013); Audio materials such as tape recording cassette, cartridge, radio, dice, telephone, teleconferencing, laboratories, Instructor's voice etc. all appeal to these sense of hearing; Audio-visual materials. According to Ogunlade (2007), audio-visual materials includes television, video, movie projectors, motion pictures with sound tracks, slides and film trips projection with sound tapes, films and multimedia. They appeal to both sense of hearing and sight. Materials/software includes graphic materials, printed materials, slides, filmstrips, overhead transparency, tapes cassette and motion pictures. Equipment/hardware: examples include black boards, tape recorders, projectors and video recorders. They are used in presenting materials or lectures. Onasanya (2004), added that flip charts could be used as a speaker support and key point reference.

Electronics: this comprises of radio, computer, e-mail and multimedia. These teaching materials makes teaching and learning process more easy and concrete. Non-projected

media includes books and other printed materials, objects, specimens. Models, graphical materials, bulletin boards that exhibit blackboards, buildings, field trips simulation and games. Two-dimensional instructional materials include flat pictures, graphs, charts, posters, comics, cartoons, slides and films. They are also non-projected materials with characteristics of being flat and light and may be opaque or transparent. They have length but no height; hence they are 2 dimensional aids. Three-dimensional instructional materials include: models, mock-ups objects, specimens, laboratories, simulation and games. They are non- projected materials. Characteristically, they have length, breadth, height. Hence they are called 3 dimensional. Onasanya (2004), opined that models and mock-ups are three dimensional representation of a real thing.

Instructional materials generally make the teaching process easier. However, in order to be pleased about the significance of instructional materials in the teaching-learning process by Martins, (2013) consider the reasons for using them. They include to help: Provide a common framework of experience to a large number of learners, facilitates the understanding of abstract explanations, focus attention on highlight of key points, provide visual aspects to a process or techniques, create impacts, gain and hold the attention of the learners and stimulate reality. Instructional materials play a very big role in teaching and learning process. Resources for teaching science could be print such as textbooks, workbooks, journals, periodical, mounted display and non-print such as films, videotapes, television (Agun and Imogie (1988), Fakomogbon, 2000).

2.1.3 Relevance of books in education

Books play a vital role in the effective delivery of appropriate education. Over the years, there has been a rising order for a well-articulated and coherent policy for the promotion of books development, production, supply, distribution and use (Oboli, 2006). To produce books, there must be a publishing industry. According to Okwilagwe and

Gannis (2005) publishing is to make open, to send forth among the people the words and pictures that inventive minds have shaped, the editors have worked over that printers have reproduced. It is only when a manuscript has been transformed into a book and then distributed to its intended market place, that the process of publishing is complete. Books play an important role in education because of their close relation to classroom instruction. In the words of Read (2002), books are perhaps the most vital elements in educational programmes and thus the entire growth process of developing countries are books which are essential for teaching and learning. They also attempt to specify how classroom lessons can be structured with suitable exercises and activities.

According to Rao (2001), the term book denotes both message (words and images) and medium (Bound paper). The use of textbooks in educational tutoring dates back to the beginning of learning itself. Teachers and students similarly depend very much on textbooks as sources of information content. They serve as good reference materials for teachers and students rely on textbooks for doing their assignments. Teachers use textbooks for preparing their lesson plans and notes. They utilize textbooks during their classes and as well in preparing tests and examinations. Textbooks are utilized at all levels of education. As a consequence of the importance of textbooks in the educational process, the textbook industry all over the world is huge and blooming. Teachers and other professionals put their experiences together in writing books in different disciplines. Facts in different fields are universal and there is need to have knowledge from various shades across the globe.

2.1.4 Concept of printed books

As a physical object, a book is a stack of usually rectangular pages (made of papyrus, parchment, vellum, or paper) oriented with one edge tied, sewn, or otherwise fixed together and then bound to the flexible spine of a protective cover of heavier, relatively inflexible material. The technical term for this physical arrangement is codex (in the plural, codices) (Vermeer, 2016). In the history of hand-held physical supports for extended written compositions or records, the codex replaces its immediate predecessor, the scroll. A single sheet in a codex is a leaf, and each side of a leaf is a page. As an intellectual object, a book is prototypically a composition of such great length that it takes a considerable investment of time to compose and a considerable, though not so extensive, investment of time to read. This sense of book has a restricted and an unrestricted sense. In the restricted sense, a book is a self-sufficient section or part of a longer composition, a usage that reflects the fact that, in antiquity, long works had to be written on several scrolls, and each scroll had to be identified by the book it contained.

Books can consist only of drawings, engravings, or photographs, or such things as crossword puzzles or cut-out dolls. In a physical book, the pages can be left blank or can feature an abstract set of lines as support for on-going entries, i.e., an account book, an appointment book, a log book, an autograph book, a note-book, a diary or day book, or a sketchbook. Some physical books are made with pages thick and sturdy enough to support other physical objects, like a scrapbook or photograph album. A printed book is basically a set of printed sheets of paper which are put together and encased in a protective cover. A printed book can be felt physically. One can just touch it, and feel the texture of pages (Vermeer, 2016).

The appropriate use of images can be particularly important in science textbooks, where many abstract concepts have a visual component and can be overly reliant on background knowledge. The skills of visually interpreting scientific data can benefit learning while promoting scientific literacy, and textbooks fail to support these benefits when images represent simple facts instead of ongoing processes (Rybarczyk, 2011). Less than five percent of introductory college biology textbook images relate to scientific investigation, contributing to the misconception of science as simply a collection of information (Duncan, Lubman, and Hoskins, 2011). Of the many factors affecting the quality of textbook images, students have reported dissatisfaction with images that are overly complex or mislabeled (Gonzalez-Espada, 2009).

Advantages of printed books

The main advantage of a printed book remains to be the whole experience of touching and flipping the pages of a book, as a tangible item. People love to collect them and often look at the storage as a small library of their own. Printed books revolutionized the world nearly 600 years ago, and since then they have influenced every part of the world, specifically in culture and science. They gave people chance to share their ideas and thoughts with the whole world. No need for an e-reading device, no batteries needed, the only thing that is needed is the book and it can be opened as soon as it is purchased. Understand ability – Portions inside the book can be marked and note taking for easy understanding. Tangibility, choosing printed book is opting for prolonged existence and tangibility. It has ability to be seen forever on the shelf with other books. It is for everyone, even the non-computer literate readers will find no worries with printed books when they want to read.

Inconvenience, they can be heavy and hard to carry around; Lighting – External light is needed for reading especially at night; Lack of space – printed books can take up a lot of space in the home.

2.1.5 Concept of electronic books

E-book stands for electronic book. It is an electronic version of a conventional printed book. An e-Book can only be seen electronically. One cannot touch the pages, however, can easily view the content with devices like computers, laptops, e-Book readers, etc. it depends upon the reader that what kind of experience he prefers over the other. E-books are becoming more and more popular among people. An e-book is a book in electronic format. It is downloaded to a computer, PC, Mac, laptop, PDA or any other kind of computer, and is read on the screen. It can have numbered pages, table of contents, pictures and graphics, exactly like a printed book. It is very simple and easy to purchase and download e-books through the Internet. It is exactly like purchasing any other product. The only difference is that after payment you will either be directed to a download page or receive the download link in an email. All you have to do is click on the link and the e-book will automatically download to your computer, to a folder of your own choice (Carreiro, 2010).

E-books are basically text, images, and even audio/video packaged into a single electronic file. For example, if you type a document in MS Word (or Open Office Writer), then save that document, that is already an e-book. As you can see, you may already have been involved in e-book publishing without your quite knowing about it. While an e-book can exist in different formats (i.e., PDF, EXE-compiled HTML pages, PDA format), and the most used format is epub, and people usually need to convert pdf to epub format for reading. E-books usually share similar advantages and disadvantages.

Advantages of E-books

Low update cost: When the author needs to update certain parts of the e-book, she simply edits the electronic document, saves the updated version, and then informs customers about the new release. The customers are either sent to the download page on the web, or are emailed the new version. In the case of a printed book, the publisher will probably have to make a minimum production run of 1000 copies. This takes time and money.

Multimedia format: Unlike your usual printed books, e-books can contain not only text and images, but also audio and even video. This way, if the reader isn't the type of person who likes to read paragraphs of text, he or she can choose to listen to the audio version. If your e-books are of pdf formats and you want to read it as a text format, then you can convert pdf to text. It is east for e-books. Some e-books even have flash applications that allow the reader to "interact" with the contents (i.e., drag images around using the mouse). This is useful for kinesthetic learners.

Searchable: A number of e-books sport a Search button, which allows you to quickly jump to the page containing the word you are interested in. Ever try opening a dictionary (the printed one)? Try an electronic version and marvel at the speed of the search feature. No shipping cost:Since we're dealing with electronic files, you can simply download them from the web. There's no need to ship any physical product halfway around the globe, and you won't have to wait as long as you normally would when be ordering books from, say, Amazon.

Disadvantages of E-books

Not convenient to read: Who wants to sit in front of a computer or screen for hours just reading your e-book, right? Aside from gaining weight, sitting for prolonged periods of time can cause muscle strain, backache, and even an elevated cholesterol level. Printing cost: It's painful to read off a screen, and some people prefer to read text on paper. If you distribute an e-book, your customers will most likely print it. And if your e-book is quite long, the printing cost will be shouldered by your readers. It is the same to dwg autocad users, your customers may prefer to read your graphic by printing it out, but dwg format is not compatible on many printers, but pdf format can. Thus, you need to convert dwg to pdf. A printed book, on the other hand, is already bound and ready to take anywhere.

Piracy: In the printed book world, people who want to "share" your book will photocopy it, and then send it to their friends. With e-books, your file can be easily emailed to someone living thousands of miles away. It can even be placed in a public server for anyone to download. With paper books, you can easily read even while standing (inside the elevator, for example). That's not the case with e-books.

E-books are not an improvement on the printed books but they are an addition to the printed books (Winterson 2012). E-books are regarded as arguably the most significant development to affect the literary world since the founding of project Gutenberg in 1971. The e-book became a somewhat mainstream reality in 1970s, when an American millionaire Michael Heart founded project Gutenberg first made digitized version of e-books fallen into the public domain, widely free (Pelle, 2009). Carreiro (2010) suggested that the unsolidified definition surrounding e-book is a problem. Consequently, an understanding of the term book may be an Ideal starting point in order to further understand the term e-book. In principle, an e-book is quite similar to a printed book in which the medium is different either paper or electronic (Van der Velde and Ernst, 2009). Ardito (2000) describes how Andries Van Damm coined the phrase "electronic book" in 1967 as the concept that refers to both the electronic content and the computerized Device used to store and retrieve the content. The online books called Electronic books (E-books) they provide an alternative to the common textbooks. Good as the idea of e-book is, access to these books is an issue.

However, with the continuous reduction in the prices of digital technologies like computers, smart phones, handsets, I-pads, and Internet bandwidths, access to electronic

books is expected to improve and teachers as well as their students will have better access to books for use An e-book is an electronic text that constitutes the digital media equivalent of a conventional printed book, sometime restricted with a digital rights management system (Adelakun, 2010). However, not all e-books have a paper version, some e-books are written as born-digital books, while thousands of existing print works have been digitized, and a small number are published in parallel with the printed. Some are produced simultaneously with the production of a printed format, as described in electronic publishing, though in many instances they may not be put on sale until later date. Often, e-books are produced from pre-existing hard-copy books, generally by document scanning, sometimes with the use of robotic book scanners, having the technology to quickly scan books without damaging the original print edition. As a newer development, sometimes only the electronic version of a book is produced by the publisher. It is also possible to convert electronic book to a printed book by print on demand. Landoni (2003) sees e-books more as an attempt to overcome the limitations of paper books.

With different definitions in the various sources, the e-book definition pertinent to this study is that of an electronic format digitizing one or more printed books or a content completely produced in electronic environment that can be displayed, accessed, published on a desktop computer, on any hand-held device with screen or in any custom-designed electronics. They will of necessity include a book reader hardware and rich text features software (adding bookends, text marking, note taking) to allow for the same functions performed during traditional reading (Önder, 2010).

The electronic format of e-books according to some researchers gave advantages to ebooks over printed books. (Vasileou *et al.* 2009) posted that development in technology and Internet have changed the nature of digital content and its accessibility and have opened up new opportunities for the publishing industry". Not only publishing industries, the technology also has potential in enhancing research, teaching and learning in the academic institutions. Pelle (2009), states that "what transpires is that the rise of e-books is restricted largely to the academic sector". E-books have become tools of choice for researchers and students, particularly those belonging to the so-called digital generation who can access and browse contents at any moment from their laptops.

E-book readers are devices that serve as hardware for e-books and reading materials. (Cavanaugh, 2006). Basically, these e-book readers are the devices used to read e-books; these could be hand held or not, dedicated or not; the software that enables the display of e-books on PCs or other devices may be referred to as e-book reader software, even though some software companies such as Microsoft refer to their applications as readers (NetRead, 2000). Most e-book readers are associated with publishers such as Amazon.com Kindle, Barnes and Noble's Nook, Apple iPad with iBook. Malama, Landoni, and Wilson (2004) noted that the layout of the e-book on screen was a significant factor that affected the quality of reading experience among users substantially. A successful layout of such involves in the ease of navigation through a clear user interface, and a clear and logical structure that supports readers' sense of place in the e-book.

Reading e-books comes with a lot of advantages for users compared to reading printed books. For example; using less paper, e-books take up less space and are easy to carry, searching and note-taking is much easier, the font size can be changed as desired, purchasing is much faster and easier, preservation and protection is simple. E-books can be printed and published in a variety of file formats (HTML, PDF, LIT, PDB) (McFall, 2005; Yıldırım *et al*, 2011).

2.1.6 Comparison between electronic and printed books

MEDIA FORM: The only media required for the printed book will be paper; paper type can be varied according to its type and texture according to usage purpose, either used for a magazine or a book. There are multiple media according to the display device; there are CDs, flash memory, and the internet for e-books. - Easy access: Printed books can be accessed through publisher, printing presses and libraries; sometimes it can be hard to access. While E-book are easily accessed through the internet, so it can be distributed to millions of users worldwide once published electronically. - Information updatability: Printed books are hard to update it, because updating a printed book requires reprinting, redistributing and retransforming it again. While e-books are easily updated and redistributed with no extra cost, no reproduction; update is performed only on a certain part of the e-book (Slavin, 2008).

COST: The cost of producing printed books are high as it needs printing papers, intellectual production cost, publishing, distribution, and profitability while very low cost is needed for e-books compared to printed book, because of the decreased cost of e-book media. - Educational effectiveness: For printed books, there low educational effectiveness while e-books have very high educational effectiveness as it depends on multimedia which has a higher educational effectiveness proved by researches results and practical experiences. - Reader health: Printed books causes no harm to reader, and non-stressful while e-books may cause eye pressure because of the reading focus towards the screen of e-book reader. - Reading devices: Printed books do not need special reading devices while e-books require a reader, either by PC tablets or mobile devices.

There is a capability to search for a text, word, or part of a text very quickly; besides page access can be performed more easily and quickly. Interactivity: No interactivity in printed book, some call it the silent teacher Distinguished by the high interactivity through links, buttons and programming tools in hypertext. Special Needs: Incompatible with disabled or with special needs There are multiple forms of e-books in order to be compatible with disabled with special needs; possibilities to change colors, backgrounds, advanced audio text, video, and so on of multiple multimedia which are suitable for different categories. Environment preservation Residues are huge, can cause environmental pollution when being disposed E-books are environment friendly; its usage never results in any environmental residues (Slavin, 2008).

2.1.7 Uses of e-books and printed books in teaching and learning process

A printed book is basically a set of printed sheets of paper which are put together in a protective cover. A printed book can be felt physically. One can just touch it, and feel the texture of pages (Vermeer, 2016). Studies have focused on finding the purpose of using e-books among readers. The result clearly shows that readers mostly use e-books as an added learning tool. According to Noorhidawati and Gibb (2018), students use e-books for four main purposes; Fact finding, finding relevant content selective reading and extended reading. This observation is supported by Letchumanan and Tarmizi (2011) study that show students prefer to use e-books for their research work than as course textbook as e-books are easier to find and easy to manage for their research work.

In Nigeria, Thomas (2011) investigated the awareness, availability, usage, source of ebooks, frequently of use and problems encountered in the usage of electronic books in five tertiary institutions in Nigeria. Although 92% of the respondents in his study were aware of e-books, he concluded that e-books use was still in the early stages of development in Nigerian academic libraries. More students use portable electronic devices to take lecture notes in class rather than hand write. As Buckley and Johnson(2013), mention, "more students and faculty using portable electronic devices, and e-book databases now provide more downloading capabilities." However, students still prefer print versions of textbooks although e-books are usually cheaper to purchase. Kolowich (2012), stated that e-textbooks show signs of finally gaining traction, although they still account for a smaller share of all textbook purchases than any method of acquiring a print textbook." Most e-textbooks purchases by students are because of professor mandates. Advantages of e-textbooks are the digital enhancements and interactive weblinks provided by publishers within the e-textbook. Publishers include practice quizzes, flashcards, find options, table of content links, and other resources for content reinforcement whereas the common textbook is not interactive. Rebora (2013) suggested that "e-book publishers are increasingly trying to make their products look and function more like printed books, even as efforts to add cutting-edge interactive enhancements to digital books have seemingly foundered."

2.1.8 Effects of printed books and e-books on academic achievement

In the past few years, technology has really been pushed into educational classroom settings. Teachers are now able to use Smart Boards to do interactive read aloud with the class. Students are able to complete math and reading assessments through multiple effective computer programs. Students also may have iPads, tablets, or computers at home that they are constantly drawn to for entertainment purposes. These technological tools are leading to gaining student interest. However, even though students are drawn to using a tablet for gaming purposes, using e-books on tablets can be effective for literacy development. Using e-books for student development in literacy is an important topic to research. An e-book can be an effective tool that can gain student interest and
motivate them to complete the task at hand. According to Brown (2016), literacy involves understanding all forms of meaning that are represented within a set of social practices embedded in culture.

In order to incorporate literacy into classrooms, teachers must come up with using different literacy practices within the classroom. A child should be able to "actively read, interpret, talk back to texts, as well as identify the many visible and invisible messages that comprise these texts" (Harste, 2010). In the 21st century, a child must be able to use both a print and technology based text that connects in and out of school events. This shift also affects students who prefer the use of a printed copy text and are not familiar with how to use e-books. Children who are not given an early exposure to technology due to being in a low economic status setting, may enter school with a learning disadvantage. If schools move away from having a hard copy library available to students and focus more on e-books to comprehend the passage. Strategies that help students develop effective ways to use e-books must be taught due to this shift.

Literacy instruction has been undergoing exceptional shifts that have changed traditional learning skills to new literacy skills. According to Larson (2010), the International Reading Association emphasized the importance of integrating information and communication technologies (ICTs) into current literacy programs. Literacy programs must include multiple sources that include digital and electronic books. Traditionally, a text was defined as "written-down messages and symbols in the forms of books, magazines, and newspapers" (Larson, 2010). Students would read from these sources and have to comprehend and make meaning of what was being read. Based on the demands of the new literacy skills, students must be exposed to texts that are more than just images and written words on a page (Larson, 2010). However, it is

important to note that teachers must keep rich texts that will aid to digital devices or electronic books in their instruction. In a study conducted by Bearne (2005), research shows that children are very involved with the multimodal interaction. Combining the multimodal and multimedia interactions will be an advantage for students in the classroom to enhance literacy development.

With e-books some studies have shown that multimodal features that are included with electronic books such as animations and sounds, may become too distracting to students (Dundar and Akcayir, 2012). Even though these multimodal features may be somewhat distracting towards some students while making meaning or reading, motivation to get students to read has increased. Ciampa (2012), argues that "a major step in preventing early reading difficulties and reducing this gap is to ensure that early reading interventions that emphasize motivation for reading". If e-books have the power to motivate students to read, students will want to motivate to become good readers. According to Mallory, *et al.* (2010), there are specific reading tasks to use when trying to motivate students to read and become good readers. These tasks include allowing students to select among a variety of readings and strategies that must be completed with the readings (Mallory, *et al.*, 2010).

According to Javorsky and Trainin (2014), "early childhood teachers must increasingly adapt their instructional practices to ensure that all emergent readers are learning to navigate digital stories effectively". In order for students who already lack the literacy exposure necessary before entering school, early childhood teachers must be teachings students how to use new literacy skills and how to use multimodal school within ebooks effectively. Giving the students the availability to using e-books, choosing the story or text, using the built-in dictionaries, narrative reading features, will allow the students to feel in control and confident in being a good reader and motivated to read more. Students who are entering school from different ethnical backgrounds, low socioeconomic status, or speak a different native language must have teachers that increase their use of using new literacy skills effectively. The use of e-books can be used in the classroom to help promote student's reading comprehension. This research was conducted to see if e-books would affect student reading comprehension more or if print books would affect student comprehension more. Based on my data and findings, e-books have the greater impact on helping student's reading comprehension skills. Before students began interacting with e-books, students were given pre-reading assessments using print copy books to test their reading retell comprehension skills. Then, students interacted with the e-books and the enhanced interactive features included with the e-books. Students were to read a book off of the e-book and were tested again on retell. More than half of the students went up in retell comprehension scores. Therefore, this study concludes the fact that e-books are a more beneficial tool to use for reading comprehension.

2.1.9 Attitude towards the use of printed and e-book

The growing availability of electronic books has begun to affect students' perceptions and attitudes toward them, and students consider electronic books to be better than Printed books. The growing availability of e-books to users has begun to affect user perceptions and attitudes toward electronic books, especially as libraries have reached a critical mass in electronic book collection numbers, creating more access and usage opportunities (Shelburne, 2009).

Students' attitude on the use of any instructional materials in the course of teaching and learning can be associated with the perceived usefulness or ease of use as propounded by Davis, (1989) in his Technology Acceptance Model (TAM). In the course of attitude, TAM takes forward the idea that an individual's actions can be predicted from a number

of known variables which constitute two factors: perceived ease of use and perceived usefulness. Perceived ease of use is defined by Davis (1989), to be the degree to which an individual believes that a particular system would be free of effort while perceived usefulness is the degree to which an individual believes that a particular system will enhance job performance. The acceptance and usefulness of any mode of delivering is guided with varied person's attitude that can range from individual to community. The model however, was significant in assessing students' attitude on the use of CD based instructional materials in the course of teaching and learning at OUT. A study done by Adewole-Odeshi (2014), on the attitude of students towards e-learning in South-West Nigerian Universities revealed that, students had positive attitude towards e-learning because they found the system easy to use and useful for their course work and therefore they had the intention to use an e-learning system.

2.10 Students retention in Genetics

Educator and researchers have examined the effectiveness of grade retention for decades. From early 1980s to the present, opinions regarding the merit of grade retention have varied from being positive for some students and in some circumstances, to being overwhelmingly negative and of little value promoting academic achievement in others. (Kadar, 2001; Keels, 2004; Lehr, 2004; Salinitri, 2005; Thayer, 2000; Tinto, 2000; Walters, 2004; White, 2005). Programs and initiatives designed to support undergraduate retention should address both formal and informal student experiences inside and outside the classroom. Habley (2004), found that the interactions students have that concerned individuals on campus (faculty, staff, advisors, peers, administrators) directly influence undergraduate retention. To this end, Tinto (2004), suggested that to improve undergraduate retention all institutions of higher education

must offer easily accessible academic, personal and social support services. The interactions students have on campus with individuals in academic, personal and support service centers can influence a students' sense of connection to the college or university as well as their ability to navigate the campus culture, meet expectations and graduate. A university that holds high expectations and actively involves students in their learning creates an environment where students are more likely to succeed.

2.2 Theoretical Framework

This section examines theories supporting the use of electronic books and printed books.

Literacy Theory

In the 21st century, literacy has become an essential tool that keeps changing over time. According to Freebody and Luke (1990), literacy is a multidimensional process that is highly dynamic and overtime is constantly changing. Today, a society demands that by the time a student graduates high-school, he/she must be college and career ready. Freebody and Luke (1990), define an individual of literacy as a social individual with the end objectives of understanding and asking questions of the text. The individual must engage with the text and be actively involved with the text as well as demonstrating knowledge with the social and cultural compounds of the text. Freebody and Luke's roles for successful reading support the cultural demands and expectations for reading and writing (1990). When reading across content-area or different subjects students must be able to decode, make-meaning, analyze the message from the author and create their own meaning and connections based on their own background knowledge and perspective.

New literacy theory

For this particular study, the New Literacies theory will guide research planning and action. New Literacies can be defined as learning that is not bound to any one specific setting or time and learning occurs every day in community activities as well as schoolbased learning events (Larson and Marsh, 2005). Lankshear and Knobel's (2007) definition of literacy is informed by this New Literacies theory. Lankshear and Knobel (2007), define literacy as a socially perceived way of communicating and deciphering content through the active participation of Discourses. New Literacies involves using technology that is now a part of our culture. Lankshear and Knobel (2010), believe that if one is communicating socially, participating, and using Discourses that is literacy and it is perceived by New Literacies because communicating and using knowledge across any medium is also literacy. The way children acquire language and literacy before entering school is being exposed to language. When infants are born, they are immediately exposed to the language around them. As students grow, they are exposed to the resources available to them provided by their parents/guardians, the community around, and educational resources. Korat and Shamir (2007), belief that students and people gain their language skill set in the natural settings they are exposed to and create meaningful orderly status in the complex society they are a part of. Today, children and adults are engaging constantly with technology. Technology is shaping the young minds and our classrooms. Technology has been an outstanding change in the world and has led to many different things, but most importantly people need the new literacies to navigate technologies in the world today.

Technology has been a constant change and upgrade, beginning long ago with the pencil, giving people access to communicate in different ways. Now children are able to use a cell phone to send text messages in seconds to anyone who has a phone. At home, some parents are economically comfortable and have the means to supply their homes

with technology. This technology in a student's home is what drives his/her motivation and gains their interests. They enjoy the social media aspects that allow them to keep in constant communication with peers and friends and they enjoy the gaming that they participate with friends. Technology is the ultimate tool that allows students to keep in constant communication with the world. This phenomenon has now moved into the classroom. Teachers may use technology to guide their unit and lesson plans, teachers may use technology to conduct assessments and collect data to drive lesson plans, and also teachers can use technology as reward systems to gain student motivation. According to the Lankshear and Knobel (2010), the New Literacies theory involves communicating and deciphering content. With technological tools, like an electronic book children are able to do so. The electronic book is a tool that teachers can implement into the classrooms for all types of learners. An electronic book or e-book, includes multiple features that may enhance a student's reading and understanding.

2.3 Empirical Studies

Young (2009), reports that some of the 240 students who adopted e-textbooks in a pilot e-textbook program using Sony e-book readers had some difficulty using e-readers due to text layout differences between print and e-textbook copies so they switched to using e-textbooks on laptops and computers. Even after the switch, Young stated that almost 40% of students surveyed report that they study less because "the e-textbook makes studying more difficult" (p. A18). Young also reported that some students wish for more classroom time designated for how to use the e-textbooks, and others note that color graphs on a black and white e-reader appear unclear.

Woody, *et al.* (2010), surveyed 91 undergraduate students about their use of an etextbook in a psychology course, and the majority of students reported a preference for the print textbook over the e-textbook. A study conducted by Folb (2011), assessed the use and factors affecting use of e-books by all patron groups of the Health Sciences Library System. A total of 871 patrons completed the survey, for an approximate response rate of 18.5%. The results indicated that library e-books were used by 55.4% of respondents and that, in general, respondents preferred print for textbooks and manuals and electronic format for research protocols and reference books. In spite of little promotion, 65.5% were aware of the e-book collection.

The Springer e-book (2011), pilot project surveyed users of University of California libraries. 58% of survey respondents reported using e-books in their academic work; 38% reported not using e-books; and 4% were not sure of their e-book usage. Postgraduate researchers were the highest users of e-books (68%) %), followed closely by graduate students (67%), undergraduate students (55%), and faculty and lecturers (57%). Respondents in the physical sciences and engineering reported the highest rate of academic e-book usage (68%), followed by those in the arts and humanities (57%), life and health sciences (57%), social sciences (54%), and business and law (47%).

Li *et al.* (2011), carried out a study and reported that a majority of the undergraduate students responding to a University of California Libraries survey regarding e-books stated that they preferred print books. The respondents in the University of California Libraries study with the highest preference for using e-books are postdoctoral researchers, graduate students, and faculty, especially when using the e-books for discovery and search tasks. Li *et al.* (2011) also report 58% of undergraduate students survey report indicate a preference for print books while 27% preferred e-books. The survey report indicates that students had difficulty "learning, retaining, and concentrating while in front of a computer".

A study probing into the preference of e-books over printed resources and its effect on learning (N=109) has unravelled that students generally prefer printed materials and as

regards learning there is no significant differences between two formats (Annand, 2008). A different study (Woody, *et al.* 2010) parallel to the findings of previous research has also provided the conclusion that as course material, students prefer printed textbook rather than e-book (N= 91). In another study (N=538), grades of university students from a course and perceived learning score were compared according to preference of electronic book or printed resource within the scope of a course. Although there is not a significant difference in the sense of grades as a result of study, perceived learning scores of students who prefer e-book was higher (Szapkiw, *et al.* 2013).

In a study examining the e-book usage patterns of university students (İsmail and Zainab, 2005), use and non-use of e-books are determined by several circumstances in a model. This model has four dimensions that interact with each other; technological competencies, users own cognitive makeup, the level of access to e-books, and the types of function or use made of the e-books. In the study although about 70% of the participants rated positively on the e-book service and rate themselves as skilled in Internet use and have positive attitude towards the e-book service, the level of e-book use is low (39%). The students become aware of the e-book service mainly while visiting the university library website. In a study which demonstrated the ratio of e-book use as 37% (Letchumanan and Tarmizi, 2010). It has been detected that use is basically dependent on access and the students who have no previous familiarity with this technology have no tendency to use e-books either.

Users switching from non-IT artifacts to IT artifacts to determine different types of switching predictors by examining data from a longitudinal study of users switching from print books to e-books was investigated by Sanford (2013), specifically, Sanford (2013), sought to examine what factors predict user tendency to switch from a print

book to an e-book and how these factors enable or constrain artifact switching. Sanford (2013), used migration theory (Sanford, 2013), from the human geography literature, and applied it to artifact switching in order to better understand the process with regard to users switching from print books to e-books. Migration Theory was developed to explain why people migrate from one place to another (Sanford, 2013). Migration Theory understands human migration in terms of certain factors that affect people: push factors, pull factors, intervening obstacles and individual differences. Sanford (2013) applied these factors to explain artifact switching with regard to users switching from print books to e-books.

A study investigated the use of and future of e-books in academic institutions in Nigeria by conducting a study at the Niger Delta University. Posigha (2012), examined if there were any differences in how academic staff from two different faculties used e-books and also if there were any differences in how male and female academics used e-books. Posigha (2012), tested three hypotheses with his study with regard to the use of e-books, postulating that there is no significant relationship between: 1. Basic medical science lecturers and education lecturers 2. Female and male lecturers 3. The constraints encountered by female and male lecturers (p. 798) Posigha's data were analysed with a chi-square test to test the three hypotheses. Posigha (2012), found that all the participants make use of e-books in their research and teaching. In comparison, Lamb (2012), found that 94% of the academics had used an e-book relevant to their primary subject area but that only 63% are using e-books in the course materials or course readings. Corlett-Rivera and Hackman's (2014), study found that 31% of respondents never used e-books for research. It is hard to make direct comparisons between these studies as they asked different questions of their participants however it would appear that their results are somewhat at odds in terms of to what degree academic library users are using e-books for research or teaching. There is evidently still much work to be done to discover how often academics and students are making use of e-book collections and this study adds to a better understanding in this respect.

Posigha's (2012), study investigated the use of and future of e-books in academic institutions in Nigeria by conducting a study at the Niger Delta University. He examined if there were any differences in how academic staff from two different faculties used e-books and also if there were any differences in how male and female academics used e-books. Three hypotheses were tested with his study with regard to the use of e-books, postulating that there is no significant relationship between: basic medical science lecturers and education lecturers; female and male lecturers; the constraints encountered by female and male lecturers.

In 2013, Emilie conducted a survey that comprised students and faculty at five U.S. universities where e-textbook projects were implemented and found that students were receptive to e-book use because they were cost effective in comparison with paper books; however, many students reported that e-books were not used to interact with other students and professors and there was difficulty in navigating the e-books. These attitudinal studies indicate that while some undergraduate students are willing and interested in adopting e-textbooks or e-books for use in their coursework, it is rare to find overwhelmingly positive attitudes towards e-books. Stone and Baker-Eveleth (2013), applied the expectation-confirmation model and found that attitude and perceived usefulness of e-books influence electronic continuance intention of e-book use.

Nick (2014), study participants were splinted between male and female relatively evenly but with more males at 52.78% compared to 46.24% females. Gender showed a statistically significant relationship with perception of the percentage of practical overlap between printed book collection and e-book availability. Almost half, 49.23%, of all females believed the practical overlap was 20% - 39% which was higher than the whole sample with 42.60%. In contrast the males had a higher percentage for the 0% - 19% answer with 37.85% compared to only 32.31% for the whole sample and just 25.38% for females.

Liaw and Huang (2014), also explored the use of e-books as a learning tool. The authors developed a research model based on the activity theory approach, a frame work to investigate how social systems work while completing activities, to understand learners' attitudes toward e-books. The results suggest that the screen size could affect learners' perceived self-efficacy. They also found that the interactivity of e-books could have positive effects on students' perceived attitude with the usefulness of e-books as a learning tool.

Murat (2015), conducted a research on educational faculty students and views about use of E-books by administering questionnaires to 1179 students attending an education faculty (660 females, 519 male) using qualitative and quantitative methods together and revealed that the students did not have sufficient knowledge about e-book and that they regarded any digital source on the Internet as e-book.

Owino *et al.* (2015),paper focuses on student's attitude towards Biology and how it influences their performance in examinations in Kenya, using a sample of 730 Biology students, 18 Biology teachers and 14 principals in his study. Owing to the varied nature of the schools, stratified sampling was used. Three categories were used for equal representation for boys", girls" and mixed schools. During sampling, 40% of the girls", 100% of the boys" and 85% of the mixed schools were used and students were presented with a set of Likert Scale to report on attitude of students towards Biology.

Asogwa (2016), investigated the effects of computer simulation instructional packages on senior secondary school students' achievement and retention in genetic concepts. The study adopted a pre-test, post-test quasi-experimental design with non-equivalent groups. Four research questions were formulated to guide the study. Four null hypotheses were posed and tested at 0.05 level of significance. The population of the study was all the 8,109 Biology students in Gombe central education zone, Gombe state, Nigeria. The sample of the study constituted 121 students derived from the two purposively selected co-educational Senior Secondary Schools in the study area. Data was collected using Genetic Achievement Test (GAT) and Genetic Retention Test (GRT). Mean and standard deviation were used in answering the research questions while Analysis of covariance was used to test the null hypotheses. The study revealed that interactive computer simulation instructional package has significant effect on improving students' achievement and retention in genetic concepts than computer simulation package without interaction. The result also revealed that gender has no significant effect on students' achievement and retention in genetic concepts when exposed to either of the packages. It was recommended that Biology teachers should adopt the use of interactive computer simulation instructional packages for teaching genetics in senior secondary schools.

Emmanuel (2015), examine the study determined the effect of computer-based instruction (CBI) on students' retention in biology in secondary schools in Olamaboro Local Government Area (LGA) of Kogi State. Pre-test, post-test quasi-experimental design was adopted. The sample comprised 224 students (127 males and 97 females). Simple random sampling was used to assign intact class to experimental and control groups, while purposive sampling was used to select secondary schools that have computers in Olamaboro LGA of Kogi State. Biology Achievement Test (BAT) with

reliability Coefficient of 0.71 was used to collect data. The research questions were answered by the use of mean and standard deviation while hypotheses were tested at 0.05 significant level using Analysis of Covariance (ANCOVA). The result showed that significant difference exists (F1, 223=169.59, P=0.0001<0.05) between students taught using CBI and those taught using conventional method in favour of those taught with CBI. However, there was no significant difference in the mean retention scores between male and female students taught using CBI (F1, 124=1.431 at P=0.234 >0.05 for retention). Based on the findings, it was recommended that relevant computer based instruction packages should be developed and distributed to secondary schools as well as encouraging secondary school teachers to adopt CBI strategy in teaching of biology.

2.4 Summary of Literature Reviewed

The focus of this study was comparative effect of printed and electronic books on biology students' achievement, retention and attitude towards genetics in Niger State, Nigeria. The concepts in this study were reviewed using related research studies. Nsofor (2010), stated that "meaningful learning is the fundamental process that under lines useful knowledge acquisition and construction". Knowledge can only be acquired through books which could be printed or electronic. It has been observed by different researchers that both printed and electronic books have impacted positively on academic performance of students at all levels of `education. Researchers like Woody, *et al.* (2010) and Sanford (2013) observed that students prefer printed textbook rather than e-book. In another study, grades of university students from a course and perceived learning score were compared according to preference of electronic book or printed resource within the scope of a course. Although there is not a significant difference in the sense of grades as a result of study, perceived learning scores of students who prefer e-book was higher (Szapkiw *et al.*, 2013). Obviously, the outcome of this research study

will impact positively on literary knowledge. Hence, the need to investigate comparative effects of printed and electronic books on biology students' achievement, retention and attitude towards genetics in Colleges of Education in Niger state. To this end, this study is aimed to assess the effects of electronic and printed courseware on Biology students' achievement, attitude and retention in genetics in colleges of education.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

The procedure used for this study is discussed under the following sub-headings; research design, population of the study, sample and sampling techniques, research instruments, validation of research instruments, reliability of research instruments, method of data collection and method of data analysis.

3.1 Research Design

The research design that was adopted for this study is quasi experimental design. Specifically, non-equivalent pre-test, post-test, control and experimental group design was used. The study involved two levels of independent variables (printed book and electronic book), three levels of dependent variables (achievement, retention and attitude) and one moderating variable (gender). The research design layout of the study is given in Table 3.1.

Group	Pre-test	Treatment	Post test	Post Post-test	
Experimental Group	O_1	X_1	O ₂	O ₃	
Control Group	O_1	X_0	O_2	O ₃	

Table 3.1: Research Design Layout

Where,

 $O_1 = Observation at Pre-test$

- $O_2 = Observation at Post-test$
- $O_3 = Observation at Post Post-test$
- X_1 = Treatment for experimental group (Electronic Book)
- X_0 = Treatment for Control Group (Printed Group)

3.2 Population of the Study

The population for this study comprised all 3,458 students offering Biology as a course of study in the two Colleges of Education in Niger State, Nigeria. There are two Colleges of Education in Niger State (Federal College of Education Kontangora which comprises of 1,740 students and Niger State College of Education, Minna which also comprises of 1,718 students). Biology students in NCE two constituted the target population of the study because the Biology concept (Genetics) chosen in this study falls under NCE II curriculum. The population of students on the basis of gender in FCE Kontagora comprises 592 males and 1,148 females while COE Minna comprises 737 males and 981 females.

3.3 Sample and Sampling Technique

A total of 120 year two Biology students were selected as sample for the study using a multi-stage sampling procedure. First, purposive sampling technique was used to select the two colleges of education available under the study area (Federal College of Education Kontogora and College of Education Minna). Next, a Simple Random technique was used to assign the institutions as Experimental (E-book) group and Control Group (Printed book). Also purposive sampling technique was used to select the NCE II students. This is because they are the only students who have been long in the school and are readily available since the NCE III students usually goeson 3 months teaching practice.

Finally, intact class of NCE II students in the two Colleges forms the targeted population for the study.

3.4 Research Instrument

The researcher designed five research instruments used for this study. They are:

Printed Book of Genetics Concept (PBGC) designed with recommended biology textbooks for NCE II Biology students. The PBGC is a 30-page well-structured lesson note on genetics concepts printed in coloured form on paper. Electronic Book on Genetics Concept (EBGC) is the electronic version of the PBGC. Both appears in colour form but instead of diagrams and pictures in the printed version, the electronic version had short video clips and animations to meet the standard features of an electronic book that can be read on electronic gadgets. Genetics Achievement Test (GAT) which consists of 40-item multiple-choice objective questions with five options (A-E), out of which there is only one correct answer which attracts two and half marks each, hence, the total maximum score that a student could obtain is 100marks. Genetics Retention Test (GRT): the same GAT was reshuffled to test the students' retention ability after a period of time. A questionnaire was designed to examine the attitude of biology students towards electronic books.

3.5Validation of Research Instruments

The electronic book (EBGC), printed book (PBGC) and questionnaires were validated by three Educational Technology experts from Educational Technology Department. The Biology content on genetics was validated by two Biology lecturers from Science Education and Biological Science department all from Federal University of Technology Minna. These experts examined the face, content and construct validity of the instrument using the following criteria: the simplicity of the formats and its suitability for the level of students; the appropriateness of the graphics, simulations, text, colours and the sharpness, clarity and suitability of subject matter coverage. Based on the comments, criticism, and suggestion of the experts some items were edited, added, some were removed while some were modified. After the validation, the instrument was then used for the study. (See Appendix E in page 103).

3.6 Reliability of Research Instruments

To test the reliability of GAT, a random sample of biology students who were part of the research population but not part of the sample for the study were selected from COE Minna. The test was administered once and a reliability coefficient index of 0.82 was obtained using Kuder-Richardson-20 formula. Also, the questionnaire reliability coefficient obtained was 0.74 using Cronbach alpha reliability coefficient. Hence the instrument was considered reliable.

3.7 Method of Data Collection

The researcher visited the selected schools before the commencement of the study to obtain official permission from the school authority. After permissions were obtained, the students were being introduced to the objectives of the study. Two research assistants were trained about rudiments of the administration of the research instruments for a period of one week. Independent study of the Genetics concepts was ensured for four weeks in between was the administration of GAT as pre-test and post-test. Data was collected lasted for four weeks. After a period of four weeks of treatment, one week was used for revision after which post-test was administered. The retention test (delayed post-test) was carried out after two weeks of post-test. This was to ascertain whether the students actually retained the concept that was taught. The scores obtained from the two tests were then analysed.

3.8 Method of Data Analysis

Data collected from the administration of GAT was analysed using Mean, Standard Deviation and t-test statistics. Specifically, Mean and standard Deviation were used to answer the seven research questions while t-test statistics was used to test the seven null

hypotheses. Significance of the hypotheses was ascertained at 0.05 alpha level of significance. Statistical Package for Social Sciences (SPSS) version 21 was used for the analysis.

CHAPTER FOUR

4.0 RESULT AND DISCUSION

4.1 **Results**

This chapter presents the analysis of data collected from the Genetics Achievement Test (GAT). The results are presented in the tables.

Research Question One: What is the difference in the mean achievement scores of Biology students exposed to electronic and printed books on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question one which is presented in Table 4.1.

 Table 4.1: Mean scores and standard deviation of experimental and control group at pre-test and post-test

Group	Ν	Pre-test (\bar{x})	SD	Post-test (x)	SD	Mean Gain
Experimental	52	32.74	12.14	68.75	11.34	36.01
Control	68	33.19	11.83	52.11	13.23	18.92

Table 4.1 shows the mean scores and standard deviation of experimental and control groups at pre-test and post-test. Table 4.1 reveals that students in the experimental group (those exposed to electronic book) had mean scores of 32.74 with standard deviation of 12.14 at pre-test, and mean scores of 68.75 and standard deviation of 11.34 at post-test. Table 4.1 further reveals that students in the control group (those exposed to printed book) had mean scores of 33.19 with standard deviation of 11.83 at pre-test, and mean scores of 52.11 with standard deviation of 13.23 at post-test. The mean gain scores of 36.01 and 18.92 recorded for experimental and control groups respectively, revealed that difference exist in the mean achievement of the two groups.

Research Question Two: Does gender have any influence on the mean achievement scores of Biology students exposed to electronic book on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question two which is presented in Table 4.2.

Table 4.2. Mean second and standard deviation of male and famale students in

experimental group at pre-test and post-test									
Ν	$\operatorname{Pre-test}(\overline{x})$	SD	Post-test (x)	SD	Mean Gain				
24	33.95	10.13	67.32	12.18	33.37				
20	21.00	11.66	CD 45	10.45	20.17				
28	31.28	11.66	69.45	12.45	38.17				
	24 28	22. Weak scores and soexperimental group atNPre-test(\bar{x})2433.952831.28	22. Wream scores and standard deexperimental group at pre-test anNPre-test(\bar{x})SD2433.9510.132831.2811.66	22. Wream scores and standard deviation of mateexperimental group at pre-test and post-testNPre-test(\bar{x})SDPost-test(\bar{x})2433.9510.1367.322831.2811.6669.45	22. Wream scores and standard deviation of male and remarkexperimental group at pre-test and post-testNPre-test(\bar{x})SDPost-test(\bar{x})SD2433.9510.1367.3212.182831.2811.6669.4512.45				

Table 4.2 shows the mean scores and standard deviation of male and female students in the experimental (electronic book) group at pre-test and post-test. Table 4.2 reveals that male students had mean scores of 33.95 with standard deviation of 10.13 at pre-test, and mean scores of 67.32 and standard deviation of 12.18 at post-test. Table 4.2 further reveals that female students had mean scores of 31.28 with standard deviation of 11.66 at pre-test, and mean scores of 69.45 with standard deviation of 12.45 at post-test. The mean gain scores of 33.37 and 38.17 recorded for male and female groups respectively, revealed that difference exist in the mean achievement of the two groups.

Research Question Three: Does gender have any influence on the mean achievement scores of Biology students exposed to printed book on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question three which is presented in Table 4.3.

Group	Ν	$\operatorname{Pre-test}(\overline{x})$	SD	$\mathbf{Post-test}(x)$	SD	Mean Gain
Male	33	33.16	14.46	51.33	13.53	18.17
Female	35	33.22	13.23	53.60	12.89	20.38

 Table 4.3: Mean scores and standard deviation of male and female students in control group at pre-test and post-test

Table 4.3 shows the mean scores and standard deviation of male and female students in the control (printed) group at pre-test and post-test. Table 4.3 reveals that male students had mean scores of 33.16 with standard deviation of 14.46 at pre-test, and mean scores of 51.33 and standard deviation of 13.53 at post-test. Table 4.3 further reveals that female students had mean scores of 33.22 with standard deviation of 13.23 at pre-test, and mean scores of 53.60 with standard deviation of 12.89 at post-test. The mean gain scores of 18.17 and 20.38 recorded for male and female groups respectively, revealed that difference exist in the mean achievement of the two groups.

Research Question Four: What is the difference in the mean retention scores of Biology students exposed to electronic and printed books on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question four which is presented in Table 4.4.

at po						
Group	Ν	Post-test(x)	SD	Retention (x)	SD	(\bar{x}) Difference
Experimental	52	68.75	11.34	61.55	13.32	7.20
Control	68	52.11	13.23	40.17	12.78	11.94

 Table 4.4: Mean scores and standard deviation of experimental and control group at post-test and retention

Table 4.4 shows the mean scores and standard deviation of experimental and control groups at post-test and retention test. Table 4.4 reveals that students in the experimental

group (those exposed to electronic book) had mean scores of 68.75 with standard deviation of 11.34 at post-test, and mean scores of 61.55 and standard deviation of 13.32 at retention test. Table 4.4 further reveals that students in the control group (those exposed to printed book) had mean scores of 52.11 with standard deviation of 13.23 at post-test, and mean scores of 40.17 with standard deviation of 12.78 at retention test. The mean difference scores of 7.20 and 11.94 recorded for experimental and control groups respectively, revealed that difference exist in the retention scores of the two groups.

Research Question Five: Does gender have any influence on the mean retention scores of Biology students exposed to electronic book on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question five which is presented in Table 4.5.

 Table 4.5: Mean scores and standard deviation of male and female students in experimental group at post-test and retention test

Group	Ν	Post-test (x)	SD	Retention (x)	SD	(x) Difference
Male	24	67.32	12.18	61.23	13.32	6.09
Female	28	69.45	12.45	61.94	13.19	7.51

Table 4.5 shows the mean scores and standard deviation of male and female students in the experimental (electronic book) group at post-test and retention test. Table 4.5 reveals that male students had mean scores of 67.32 with standard deviation of 12.18 at post-test, and mean scores of 61.23 and standard deviation of 13.32 at retention test. Table 4.5 further reveals that female students had mean scores of 69.45 with standard deviation of 12.19 at retention test. The mean difference scores of 6.09 and 7.51 recorded for male

and female groups respectively, revealed that difference exist in the retention scores of the two groups.

Research Question Six: Does gender have any influence on the mean retention scores of Biology students exposed to printed book on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question six which is presented in Table 4.6.

 Table 4.6: Mean scores and standard deviation of male and female students in control group at post-test and retention test

Group	Ν	Post-test(x)	SD	Retention (x)	SD	(\bar{x}) Difference
Male	33	51.33	13.53	40.09	12.65	11.24
Female	35	53.60	12.89	41.89	12.87	11.71

Table 4.6 shows the mean scores and standard deviation of male and female students in the control (printed) group at post-test and retention test. Table 4.6 reveals that male students had mean scores of 51.33 with standard deviation of 13.53 at post-test, and mean scores of 40.09 and standard deviation of 12.65 at retention test. Table 4.6 further reveals that female students had mean scores of 53.60 with standard deviation of 12.89 at post-test, and mean scores of 41.89 with standard deviation of 12.87 at retention test. The mean difference scores of 11.24 and 11.71 recorded for male and female groups respectively, revealed that difference exist in the retention scores of the two groups.

Research Question Seven: What is the mean attitude scores of students towards Biology when exposed to electronic and printed books on Genetics concepts?

The descriptive statistics of mean and standard deviation was used to answer research question seven which is presented in Table 4.7.

 Table 4.7: Mean scores and standard deviation of responses on students' attitude

 towards electronic and printed books

S/N	Item	1	$S.D_1$	2	S.D ₂
1	I believe the use of electronic book/printed book is effective in learning Biology	3.43	0.43	2.76	0.24
2	I feel that using electronic book/printed book is an innovative way of learning Biology	3.16	0.16	2.59	0.41
3	I prefer learning Biology through electronic book/printed book	3.11	0.11	3.23	0.23
4	I will appreciate Biology better if all my course contents are converted to electronic book/printed book	4.17	1.17	3.32	0.32
5	The use of electronic book/printed book will improve my understanding of Biology	3.87	0.87	2.19	0.81
6	The use of electronic book/printed book makes Biology concepts precise and sequentially arranged	3.43	0.43	2.86	0.14
7	The use of electronic book/printed book improves my reading and comprehension ability	3.27	0.27	3.14	0.14
8	I feel relaxed and confident while learning Biology through electronic book/printed book	3.87	0.87	2.67	0.33
9	I am able to move at my own pace while learning Biology through electronic book/printed book	3.96	0.96	3.01	0.01
10	The use of electronic book/printed book allows me to be actively involved in the teaching and learning process	3.97	0.97	2.54	0.46
	Grand Mean	3.62	0.62	2.83	0.31

¹ &S.D₁: Mean Attitude Scores and Standard Deviation for Electronic Book ¹ &S.D₁: Mean Attitude Scores and Standard Deviation for Printed Book

Table 4.7 shows the Mean and Standard Deviation of response on students' attitude towards Biology after exposure to electronic and printed books. Table 4.7 reveals that the mean scores to each of the items for electronic book is constantly above the decision mean of 3.0. However, for printed book, it can be seen from Table 4.7 that only four of them items recorded mean scores above the decision mean with six items recording

mean scores that were below the decision mean of 3.0. The grand means scores of 3.62 with standard deviation of 0.62 recorded for electronic book was above the decision mean of 3.0 while the grand mean scores of 2.83 with standard deviation of 0.31 recorded for printed book was below the decision mean of 3.0. This implies that students in the experimental group agreed that electronic book improved their attitude towards Biology while students in the control group disagreed that printed book improved their attitude towards Biology.

Testing of Null Hypotheses

T-test statistics was used to analyse pretest of experimental and control group which is presented in Table 4.8.

experimental and control groups at pre-test									
Variable	Ν	Mean	SD	Df	t-value	P-value			
Experimental	52	32.74	12.14	118	2.187 ^{ns}	0.322			
Control	68	33.19	11.83						

Table 4.8: t-test comparison of mean achievement scores of students in

Ns: Not Significant @ p = 0.05

Table 4.8 shows the t-test comparison of the mean scores of students in both the experimental and control group at pre-test. Table 4.8 reveals that the calculated t-value (t=2.187, df=118, p>0.05) was not significant. Since the p-value was greater than alpha level, this implies that the two groups were equivalent at the commencement of the study. Hence, inferential statistics of t-test statistics was used to analyse the seven null hypotheses.

HO1: There is no significant difference in the mean achievement scores of Biology students exposed to electronic and printed books on Genetics concepts?

The t-test statistics was used to answer hypothesis one which is presented in Table 4.9.

expe	rimental an					
Group	N	Mean	SD	Df	t-value	p-value
Experimental	52	68.75	11.34	118	7.243*	0.001
Control	68	52.11	13.23			

 Table 4.9: t-test comparison of post-test mean achievement scores of students in experimental and control groups

*Significant @ p = 0.05

Table 4.9 shows the t-test comparison of the post-test achievement scores of students in the experimental and control groups. Table 4.9 reveals that the calculated t- value (t=7.243, df=118, p<0.05) is significant at alpha level. Hence hypothesis one was rejected. This implies that significant difference exists in the achievement of Biology students in Genetics when exposed to electronic and printed book in favour of those exposed to electronic book.

HO2: There is no significant difference in the mean achievement scores of male and

female Biology students exposed to electronic book on Genetics concepts

The t-test statistics was used to answer hypothesis two which is presented in Table 4.10.

 Table 4.10: t-test comparison of post-test mean achievement scores of male and female students in experimental (electronic book) group

Group	N	Mean	SD	Df	t-value	p-value
Male	24	67.32	12.18	50	6.743 ^{ns}	0.321
Female	28	69.45	12.45			

NS: Not Significant @ p = 0.05

Table 4.10 shows the t-test comparison of the post-test achievement scores of male and female students in the experimental group. Table 4.10 reveals that the calculated t-value (t=6.743, df=50, p>0.05) is not significant at alpha level. Hence hypothesis two

was not rejected. This implies that no significant difference exists in the achievement of male and female Biology students in Genetics when exposed to electronic book.

HO3: There is no significant difference in the mean achievement scores of male and

female Biology students exposed to printed book on Genetics concepts.

The t-test statistics was used to answer hypothesis three which is presented in Table

4.11.

 Table 4.11: t-test comparison of post-test mean achievement scores of male and female students in control (printed book) group

Group	Ν	Mean	SD	Df	t-value	p-value
Male	33	51.33	13.53	66	4.512 ^{ns}	0.512
Female	35	53.60	12.89			

NS: Not Significant @ p = 0.05

Table 4.11 shows the t-test comparison of the post-test achievement scores of male and female students in the control group. Table 4.11 reveals that the calculated t- value (t=4.512, df=66, p>0.05) is not significant at alpha level. Hence hypothesis three was not rejected. This implies that no significant difference exists in the achievement of male and female Biology students in Genetics when exposed to printed book.

HO4: There is no significant difference in the mean retention scores of Biology students exposed to electronic and printed books on Genetics concepts?

The t-test statistics was used to answer hypothesis four which is presented in Table 4.12.

 Table 4.12: t-test comparison of mean retention scores of students in experimental and control groups

	C	, <u>.</u> .					
Group	Ν	Mean	SD	Df	t-value	p-value	

Experimental	52	61.55	13.32	118	9.441*	0.000
Control	68	40.17	12.78			

*Significant @ p = 0.05

Table 4.12 shows the t-test comparison of the mean retention scores of students in the experimental and control groups. Table 4.12 reveals that the calculated t- value (t=9.441, df=118, p<0.05) is significant at alpha level. Hence hypothesis four was rejected. This implies that significant difference exists in the retention of Biology students in Genetics when exposed to electronic and printed book in favour of those exposed to electronic book.

HO₅: There is no significant difference in the mean achievement scores of male and female Biology students exposed to electronic book on Genetics concepts

The t-test statistics was used to answer hypothesis five which is presented in Table 4.13.

Table 4.13: t-test comparison of mean retention scores of male and female students
in experimental (electronic book) groupGroupNMeanSDDft-valueOfNMeanSDDft-value

Group		Wittin	50	DI	t value	p vulue
Male	24	61.23	13.32	50	5.632 ^{ns}	0.562
Female	28	61.94	13.19			

Ns: Not Significant @ p = 0.05

Table 4.13 shows the t-test comparison of the mean retention scores of male and female students in the experimental group. Table 4.13 reveals that the calculated t- value (t=5.632, df=50, p>0.05) is not significant at alpha level. Hence hypothesis five was not rejected. This implies that no significant difference exists in the retention of male and female Biology students in Genetics when exposed to electronic book.

HO6: There is no significant difference in the mean achievement scores of male and

female Biology students exposed to printed book on Genetics concepts.

The t-test statistics was used to answer hypothesis six which is presented in Table 4.14.

Table 4.14: t-test comparison of mean retention scores of male and female students in control (printed book) group

Group	Ν	Mean	SD	Df	t-value	p-value
Male	33	40.09	12.65	66	4.512 ^{ns}	0.512
Female	35	41.89	12.87			

NS: Not Significant @ p = 0.05

Table 4.14 shows the t-test comparison of the mean retention scores of male and female students in the control group. Table 4.14 reveals that the calculated t- value (t=4.512, df=66, p>0.05) is not significant at alpha level. Hence hypothesis six was not rejected. This implies that no significant difference exists in the retention scores of male and female Biology students in Genetics when exposed to printed book.

HO7: There is no significant difference in the mean attitude scores of students towards Biology after exposure to electronic and printed books.

The t-test statistics was used to answer hypothesis seven which is presented in Table 4.15.

Group	Ν	Mean	SD	Df	t-value	p-value	
Experimental	52	72.4	12.48	118	6.354*	0.001	
Control	68	56.6	13.46				

Table 4.15: t-test results of students' attitude towards Biology after exposure to electronic and printed books

*Significant @ p = 0.05

Table 4.15 shows the t-test comparison of the mean attitude scores of students towards Biology after exposure to electronic and printed books. Table 4.15 reveals that the calculated t- value (t=6.354, df=118, p<0.05) is significant at alpha level. Hence hypothesis seven was rejected. This implies that significant difference exists in the attitude of students towards Biology after exposure to electronic and printed book in favour of those exposed to electronic book.

4.2 Summary of the Findings

Based on the results analysed, the following are the findings of the study:

- Difference exists in the achievement of Biology students' exposed to electronic and printed books, as students that were exposed to electronic book on genetics concepts achieved better than their colleagues that were exposed to printed book on the same genetics concepts;
- There is no significant difference in the achievement scores of male and female Biology students exposed to electronic book on genetics concept;
- There is no significant difference in the achievement scores of male and female Biology students exposed to printed book;
- 4. Difference exists in the retention scores of Biology students' exposed to electronic and printed books, as students that were exposed to electronic book on genetics concepts recorded high retention scores better than their colleagues that were exposed to printed book on the same genetics concepts;
- There is no significant difference in the retention scores of male and female Biology students exposed to electronic book on genetics concept;

- There is no significant difference in the retention scores of male and female Biology students exposed to printed book; and
- 7. The attitude of students towards Biology was better improved when exposed to electronic book than when exposed to printed book.

4.3 Discussion of Findings

Finding that emanated from this study regarding the effects of printed and electronic courseware on biology students' achievement, attitude and retention towards genetics in colleges of education in Niger state, Minna reveals that electronic book significantly improved Biology students' achievement in Genetics better than printed book. This means that the use of EBGC can improve students' performance more than other instructional delivery medium such as PBGC. In that wise, the use of PBGC should also be extended to other science concepts / subject. Hypothesis one which states that there is no significant difference in the mean achievement scores of Biology students exposed to electronic and printed books on Genetics concepts? Is in contrast with what Young (2009) revealed. Young found out that almost 40% of students' surveyed reported that students study less because the e-textbook makes studying more difficult.

The findings also revealed that the use of EBGC gives equal learning opportunities to both male and female students in genetics. This would increase the chances of producing more professional scientists and technologists without gender bias. Hypothesis two which states that there is no significant difference in the mean achievement scores of male and female Biology students exposed to electronic book on Genetics concepts. This finding is in line with the finding of Posigha (2012), who found out that there is no significant difference in how male and female students used e-books.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In this study, efforts have been made to compare the effects of printed and electronic courseware on biology students' achievement, attitude and retention in genetics in colleges of education in Niger State. Majority of the respondents favored EBGC because they regard the use of EBGC to be more effective than other media of instruction and produce more significant achievement. More importantly, the achievement level was observed to be a strong performance indicator for the biology students, using a more effective delivery medium can improve their performance and might influence their attitude towards learning. Also, based on these findings, instructional contents disseminated through electronic books was more attractive to biology students than the printed book enhance it helped to improve their academic achievement.

5.2 **Recommendations**

Based on the findings that emanated from this study, the following recommendation were made:

- Instructional contents should be disseminated to students in form of electronic books as these would attract, enhance their independent study and improve their academic achievement, retention and attitude.
- Tertiary institutions should provide stable power supply, Information and Communication Technology facilities which will aid biology students to have easy access to open electronic resources materials.

- Government and non-governmental bodies should make provision for continuous sensitizations, trainings and workshops for biology teachers in tertiary institutions to embrace electronic book for their lesson delivery.
- Biology lecturers should adopt and utilize the use of electronic books in teaching and learning as this will help to improve their students' achievement, retention and attitude.
- 5. Students should utilize the opportunity offered by the researcher to have access to their own mobile lecture note to engage in individualized study. Electronic books can be utilized for independent study, and also useful for revision and reference purposes.
- 6. Development of innovative individualized learning approaches such as the use of electronic books in all subjects should be integrated into the curriculum of teachers' education program in Nigerian education tertiary institutions in-order to prepare pre-service-teachers for effective and efficient teaching later.
- 7. Regular trainings should be organized by tertiary bodies in form of seminars, conferences and workshops for teachers and students in tertiary institutions as this will enable them capable of exploring, developing, utilizing and maximally benefit from relevant technological innovations in teaching and learning processes.
- 8. Publishing companies should work with the universities and instructors to create online platforms for buying or downloading electronic books that facilitate learning as well as make them more accessible.
- 9. Tertiary school libraries should create more awareness on the electronic format of textbooks and the availability of electronic books in the library for both staff and students through the library website/link.
- 10. Electronic books should be encouraged in colleges of education for teaching and learning biology.
- 11. Workshop seminars, symposia and conferences should be organized periodically to acquaint new biology lecturers with recent research findings that would lead to effective and meaningful teaching and learning.

5.3 Contribution of the study to the existing body of knowledge

A large number of teachers and classroom instructors have not yet comprehended and appreciated the value of technology in realizing the objectives of education. This study;

- Could be used as an additional knowledge to the numerous importance of electronic books in teaching and learning of genetics and others concepts in biology.
- 2. Provides additional knowledge on how to explore and improve the use of personal gadgets for instructional delivery/presentation.
- 3. Enable researchers and other readers gain additional knowledge in the use of electronic books in teaching and learning of genetics.

5.4 Limitations for the Study

The following are the limitations of the study:

- 1. It was very difficult to detect the insincerity of the respondents since questionnaire is only instrument for collecting data.
- Students in other departments were not selected as part of sample of this study. Selection of sample was therefore limited to only biology students in these institutions.
- 3. The limitation during this research are electricity failure, sample size is also limitation, the researcher had to encourage student about the importance of research about to be carried out before the researcher drew attention of the sample.

4. Lastly, getting two research assistants to train was a great task as most people have abused their availability and not rewarding them after helping out.

5.5 Suggestions for Further Studies

The following suggestions for further studies are made:

- 1. Similar study should be carried out using other biology concepts with view to identifying students' problems.
- 2. Research should be carried out on the effects of electronic books in other subject areas to authenticate the validity of its use.
- Research should be carried out on the attitude of Teachers towards the use of electronic books.
- 4. A replica of this study can be conducted among biology students in other tertiary institutions in Niger state, Nigeria.
- 5. Similar study can be conducted in tertiary institutions in other parts of the country so that the scope of generalization can be attained

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APPENDIX A



GENETICS AND HEREDITY Compiled by-Aje Damilola MTECH/SSTE/2017/7432

MODULE 1 GENETICS

1.0 Introduction

In biology, the passing of traits from parents to offspring is known as heredity, Hence genetics is the study of heredity. Traits that are transferred from your parents to you and from you to your offspring can be referred to as inherited traits. This introduction takes you through basic components of genetics such as DNA, genes, chromosomes and genetic inheritance.

Genetics is what makes children look like their parents. During reproduction, DNA is replicated and passed from a parent to their offspring. The environment that we live in can also influrncr how genes are expressed.



2.0 Learning Objectives

By the end of this unit you will be able to:

- 1. Define the concept Genetics
- 2. Give examples of homozygous and heterozygous offspring
- 3. Explain genetic flow
- 4. Explain in details genetic drift

3.0 Main content

3.1 Definition

GENETICS

Genetics is the study of how heritable traits are transmitted from parents to offspring. Humans have long observed that traits tend to be similar in families. It wasn't until the mid-nineteenth century that larger implications of genetic inheritance began to be studied scientifically. The diagram below explains clearly;



Self-assessment exercise1

What is Genetics?

Self-assessment answer1

3.2 NATURAL SELECTION

In 1858, Charles Darwin and Alfred Russell Wallace jointly announced their theory of <u>natural selection</u>. According to Darwin's observations, in nearly all populations individuals tend to produce far more offspring than are needed to replace the parents. If every individual born were to live and reproduce still more offspring, the population would collapse. Overpopulation leads to competition for resources. Darwin observed that it is very rare for any two individuals to be exactly alike. He reasoned that these natural variations among individuals lead to natural selection. Individuals born with variations that confer an advantage in obtaining resources or mates have greater chances of reproducing offspring who would inherit the favorable variations. Individuals with different variations might be less likely to reproduce.

Darwin was convinced that natural selection explained how natural variations could lead to new traits in a population, or even new species. While he had observed the variations existent in every population, he was unable to explain how those variations came about. Darwin was unaware of the work being done by a quiet monk named Gregor Mendel.



Self-assessment exercise2

What is natural selection?

Self-assessment answer2

3.3 INHERITANCE OF TRAITS

In 1866, <u>Gregor Mendel</u> published the results of years of experimentation in breeding pea plants. He showed that both parents must pass discrete physical factors which transmit information about their traits to their offspring at conception. An individual inherits one such unit for a trait from each parent. Mendel's principle of dominance explained that most traits are not a blend of the father's traits and those of the mother as was commonly thought. Instead, when an offspring inherits a factor for opposing forms of the same trait, the **dominant** form of that trait will be apparent in that individual. The factor for the **recessive** trait, while not apparent, is still part of the individual's genetic makeup and may be passed to offspring.

Mendel's experiments demonstrated that when <u>sex cells</u> are formed, the factors for each trait that an individual inherits from its parents are separated into different sex cells. When the sex cells unite at conception the resulting offspring will have at least two factors (**alleles**) for each trait. One inherited factor from the mother and one from the father. Mendel used the laws of probability to demonstrate that when the sex cells are formed, it is a matter of chance as to which factor for a given trait is incorporated into a particular sperm or egg.

We now know that simple dominance does not explain all traits. In cases of codominance, both forms of the trait are equally expressed. Incomplete dominance results in a blending of traits. In cases of multiple alleles, there are more than just two possible ways a given gene can be expressed. We also now know that most expressed traits, such as the many variations in human skin color, are influenced by many genes all acting on the same apparent trait. In addition, each gene that acts on the trait may have multiple alleles. Environmental factors can also interact with genetic information to supply even more variation. Thus sexual reproduction is the biggest contributor to genetic variation among individuals of a species.

Twentieth-century scientists came to understand that combining the ideas of genetics and natural selection could lead to enormous strides in understanding the variety of organisms that inhabit our earth.

90



Self-assessment exercise3

Mention the difference between dominant and recessive traits

Self-assessment answer3

Scientists realized that the molecular makeup of genes must include a way for genetic information to be copied efficiently. Each cell of a living organism requires instructions on how and when to build the proteins that are the basic building blocks of body structures and the "workhorses" responsible for every chemical reaction necessary for life. In 1958, when James Watson and Francis Crick described the <u>structure of the DNA</u>

molecule, this chemical structure explained how cells use the information from the DNA stored in the cell's nucleus to build proteins. Each time cells divide to form new cells, this vast chemical library must be copied so that the daughter cells have the information required to function. Inevitably, each time the DNA is copied, there are minute changes. Most such changes are caught and repaired immediately. However, if the alteration is not repaired the change may result in an altered protein. Altered proteins may not function normally. Genetic disorders are conditions that result when malfunctioning proteins adversely affect the organism. [Gallery: Images of DNA Structures]

In very rare cases the altered protein may function better than the original or result in a trait that confers a survival advantage. Such beneficial mutations are one source of genetic variation.



Self-assessment exercise 4

What are genetic disorders?

Self-assessment answer 4

Another source of genetic variation is gene flow, the introduction of new alleles to a population. Commonly, this is due to simple migration. New individuals of the same species enter a population. Environmental conditions in their previous home may have

favored different forms of traits, for example, lighter colored fur. Alleles for these traits would be different from the alleles present in the host population. When the newcomers interbreed with the host population, they introduce new forms of the genes responsible for traits. Favorable alleles may spread through the population.



Self-assessment exercise 5

What is simple migration?

Self-assessment answer 5

3.6GENETIC DRIFT

Genetic drift is a change in allele frequency that is random rather than being driven by selection pressures. Remember from Mendel that alleles are sorted randomly into sex cells. It could just happen that both parents contribute the same allele for a given trait to all of their offspring. When the offspring reproduce they can only transmit the one form of the trait that they inherited from their parents. Genetic drift can cause large changes in a population in only a few generations especially if the population is very small.

Genetic drift tends to reduce genetic variation in a population. In a population without genetic diversity there is a greater chance that environmental change may decimate the population or drive it to extinction.

aa	Aa	AA	AA	aa
AA	aa	Aa	Aa	AA
AA	aa	AA	AA	aa
Aa	Aa	aa	Aa	aa

Conclusion

Genetics is the study of how heritable traits are transmitted from parents to offspring from one generation to other generations.

5.0 Summary

We have learned the definition of Genetics and other important terms in hereditary. We can now understand why offspring come out the way they do, Recessive and dominant traits roles in genetic flow.

6.0 Tutor marked assignment

- 1. Define the concept Genetics
- 2. Give examples of homozygous and heterozygous offspring
- 3. Explain genetic flow
- 4. Explain in details genetic drift

7.0 Further readings

https://en.wikipedia.org/wiki/Natural_selection

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https://www.google.com/search?q=dominant+and+recessive+traits
https://www.google.com/search?q=Mutation
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https://www.google.com/search?

basicbiology.net

Basic Genetics by Ahmed Abouelmagd

APPENDIX B

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION DEPARTMENT OF EDUCATIONAL TECHNOLOGY BIOLOGY ACHIEVEMENT TEST (BAT)

Institution.....

Gender.....

TIME: 3\.0MINS

INSTRUCTION: ANSWER ALL QUESTIONS BY CIRCLING THE CORRECT ANSWER

- 1. Genetics is the study of
 - a. Heredity and love
 - b. Heredity and variation
 - c. Heredity and marriage
 - d. Heredity and genes
- 2. A diploid organism has how many set(s) of chromosomes
 - a. 1
 - b. 2
 - c. 4
 - d. 3
- 3. The male and female gametes can be said to be on which of the following condition?
- a. Haploid
- b. Diploid
- c. Mutation
- d. Polyploidy
- 4. Each of "XX" and "XY" chromosomes are said to be

- (a) Diploid condition
- (b) Haploid condition
- (c) Polyploidy condition
- (d) Mutation
- 5. How many chromosomes are present in humans
- a. 46
- b. 47
- c. 48
- d. 49
- 6. What is the basic unit of heredity?
- a. Chromosome
- b. Allele
- c. gene
- d. genotype
- 7. An allele that completely dictates the appearance or phenotype of heterozygote is said to be
- a. Zygote
- b. dominant
- c. recessive
- d. gametes
- 8. An allele whose phenotype xpression is completely masked in heterozygous by the presence of dominant allele is said to be
- a. Recessive
- b. dominant
- c. genotype

- d. phenotype
- 9. Each alternative form of a gene is known as a/an
- a. Allele
- b. genotype
- c. phenotype
- d. chromosome
- 10. The observable expression of a character of an organism resulting from the interaction between its genes and its environment is called
- a. Gene
- b. genotype
- c. phenotype
- d. chromosome
- 11. The X chromosome is also known as
- a. Male chromosome
- b. unisex
- c. asexual
- d. female
- 12. The Y chromosome is also known as
- a. male
- b. asexual
- c. unisex
- d. female
- 13. The sum total number of genes present in the cell of an organism is referred to as
- a. allele
- b. locus

- c. phenotype
- d. genotype
- 14. AA is
- a. heterozygous
- b. bizygous
- c. trizygous
- d. homozygous
- 15. A diploid individual whose copies of genes are the same is said to be
- a. homozygote
- b. heterozygote
- c. chromosome
- d. gene

	RED	WHITE
PARENT	RR	rr
F1 Generation	RrRrRrRr	

Use the illustration above to answer the following

- 16. The red parent is
- a. dominant
- b. recessive
- c. zygote
- d. chromosome
- 17. The white parent is
- a. dominant
- b. recessive
- c. zygote

- d. heterozygous
- 18. The offspring produced in the F1 generation can be described are
- a. phenotype
- b. genotype
- c. homozygote
- d. heterozygote
- 19. The phenotype of the F1 generation offspring can be described as
- a. All white and red
- b. All mixed
- c. All white
- d. None of the above
- 20. The number of red offspring in the first generation are
- a. 0
- b. 1
- c. 4
- d. All of the above
- 21. What is the name of this course lecturer?
- a. Miss Dami
- b. Miss Damilare
- c. Miss Damilola Aje
- d. All of the above
- 22. What is this course title
- a. Genetics and Hereditary
- b. Genetics
- c. Genes and Generations
- d. All of the above

- 23. What does a Punnett square show?
- a. All the possible outcomes of a genetic cross
- b. Only the dominant alleles in a genetic cross
- c. Only the recessive alleles in a genetic cross
- d. All of Mendel's discoveries about genetic crosses
- 24. If a homozygous black guinea pig (BB) is crossed with a homozygous white guinea
- pig (bb), what is the probability that an offspring will have black fur?
- a. 25 percent
- b. 50 percent
- c. 75 percent
- d. 100 percent
- 25. An organism's physical appearance is its
- a. genotype.
- b. phenotype.
- c. codominance.
- d. heterozygous.
- 26. What does codominance mean in genetics?
- a. Both alleles are dominant.
- b. Both alleles are recessive.
- c. The alleles are neither dominant nor recessive.
- d. Each allele is both dominant and recessive.

- 27. What happens during meiosis?
- a. Each sex cell loses half of its chromosomes.
- b.Chromosome pairs separate to form new sex cells.
- c. Each sex cell copies itself to form four new chromosomes.
- d.Chromosome pairs remain together when new sex cells are formed.
- 28. When sex cells combine to produce offspring, each sex cell will contribute
- a. one fourth of the normal number of chromosomes.
- b. half the normal number of chromosomes.
- c. the normal number of chromosomes.
- d. twice the normal number of chromosomes.
- 29. What is a mutation?
- a. any change that is harmful to an organism
- b. any change in a gene or chromosome
- c. any change that is helpful to an organism
- d. any change in the phenotype of a cell
- 30. Which term refers to physical characteristics that are studied in genetics?
- a. Traits
- b. Offspring
- c. Generations
- d. Hybrids

- 31. The different forms of a gene are called
- a. alleles.
- b. factors.

masks.

c.

- d. traits.
- 32. Where does protein synthesis take place?
- a. in the ribosomes in the nucleus of the cell
- b. on the ribosomes in the cytoplasm of the cell
- c. in the chromosomes in the nucleus of the cell
- d. on the chromosomes in the cytoplasm of the cell
- 33. What does the notation *tt* mean to geneticists?
- a. two dominant alleles
- b. two recessive alleles
- c. at least one dominant allele
- d. one dominant and one recessive allele
- 34. An organism's genotype is its
- a. genetic makeup
- b. feather color
- c. physical appearance
- d. stem height
- 35. Which nitrogen base in RNA is NOT part of DNA?
- a. Adenine
- b. Guanine
- c. Cytosine

- d. Uracil
- 36. An organism that has two identical alleles for a trait is
- a. codominant.
- b. tall.
- c. homozygous.
- d. heterozygous.
- 37. A heterozygous organism has
- a. three different alleles for a trait.
- b. two identical alleles for a trait.
- c. only one allele for a trait.
- d. two different alleles for a trait.
- 38. Which of these traits is controlled by a gene with multiple alleles?
- a. straight hairline
- b. smile dimples
- c. widow's peak
- d. blood type
- 39. Which combination of sex chromosomes results in a male human being?
- a. XX
- b. YY
- c. XY
- d. either XX or YY
- 40. Why are sex-linked traits more common in males than in females?
- a. All alleles on the X chromosome are dominant.
- b. All alleles on the Y chromosome are recessive.

- c. A recessive allele on the X chromosome will always produce the trait in a male.
- d. Any allele on the Y chromosome will be codominant with the matching allele on the X chromosome.

APPENDIX C

ANSWERS TO BIOLOGY ACHIEVEMENT TEST

- 1. B
- 2. A
- 3. B
- 4. B
- 5. A
- 6. C
- 7. C
- 8. A
- 9. A
- 10. C
- 11. D
- 12. A
- 13. D
- 14. A
- 15. A
- 16. A
- 17. B
- 18. D
- 19. A
- 20. C
- 21. A
- 22. D
- 23. B

24. C
25. B
26. C
27. D
28. A
29. A
30. A
31. A
32. B
33. D
34. D
35. C
36. B
37. A
38. D
39. B
40. D

APPENDIX D

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF EDUCATIONAL TECHNOLOGY

QUESTIONNAIRE ON STUDENTS ATTITUDE TOWARDS BIOLOGY (E-BOOK)

Dear Respondent,

This questionnaire is designed to elicit your responses on the above subject matter. Any information given will be used purposely for research and will be treated with utmost confidentiality.

SECTION A

Please kindly give accurate responses to the following information by filling in the blank space and ticking () appropriately.

Name of Institution:

Gender.....

SECTION B

Below is the extent of use of E-book, Please tick () the response that best suit your opinion.

S/No	Items	Yes	No
1	I read e-book regularly		
2	I don't read e-book at all		
3	I use e-book for research		
4	I use e-book to read newspaper, story book, novels, etc.		
5	I use e-book to do my class assignment		
6	I read E-book via social media		
7	I read E-book through Publishers own sites		
8	I come across E-book through Internet search Engine		

9	I use E-Book to back-up my class work			
10	I read E-Book online			
11	I download E-Book and screen reading			
12	I Download E-book and print out			
13	I use E-Book materials via:			
	Smartphone			
	Tablet			
	Desktop Computer			
	E-reader			
	IPad			
14	Advantages of E-Books are:			
	Ease of access			
	Ease of Archive			
	Ease of Use			
	Ease of Read			
	Up to datedness			
	No Advantage			
SECTION C

This part of the questionnaire is based on the students' attitude towards E-books. You are requested to either agree or disagree with each statement. If you strongly agree with the statement tick (SA), if you agree with the statement, tick (A), if you disagree, tick (D) and if you strongly disagree (SD).

S/N	Items	SA	Α	D	SD
		(4)	(3)	(2)	(1)
1	I believe the use of electronic book/printed book is effective in				
	learning Biology				
2	I feel that using electronic book/printed book is an innovative				
	way of learning Biology				
3	I prefer learning Biology through electronic book/printed book				
4	I will appreciate Biology better if all my course contents are				
	converted to electronic book/printed book				
5	The use of electronic book/printed book will improve my				
	understanding of Biology				
6	The use of electronic book/printed book makes Biology				
	concepts precise and sequentially arranged				
7	The use of electronic book/printed book improves my reading				
	and comprehension ability				
8	I feel relaxed and confident while learning Biology through				
	electronic book/printed book				
9	I am able to move at my own pace while learning Biology				
	through electronic book/printed book				

10	The use of electronic book/printed book allows me to be		
	actively involved in the teaching and learning process		

SECTION D

This part of the questionnaire is based on the students' preference towards E-books. You are requested to either agree or disagree with each statement. If you strongly agree with the statement tick (SA), if you agree with the statement, tick (A), if you disagree, tick (D) and if you strongly disagree (SD).

S/No	Items	SA	Α	D	SD
		(4)	(3)	(2)	(1)
1	I prefer using E-book than Printed books				
2	I like reading electronics material because is a modern way				
	of reading				
3	I prefer to read E-Book than printed book because its stress				
	free				
4	I use e-book because is very cheap compare to printed books				
5	E-books are readily available online unlike printed books				
6	E-book can be carried about unlike printed books				
7	E-Book can be easily shared unlike printed books				
8	E-Book take up less space than printed books				
9	E-book can be more interactive than printed books				
10	E-Book makes learning interesting than printed books				

APPENDIX E

VALIDATION FORMS



FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION DEPARTMENT OF EDUCATIONAL TECHNOLOGY

Dear Sir/Madam,

Instrument Validation Form

The bearer is a student of the above named University and Department. She/he is conducting a research and you have been selected as one of those with requisite expertise to validate his/her instrument. Kindly grant him/her all necessary assistance to make the exercise a success.

Your competency and expertise was considered as factors that will serve to improve the quality of his/her research instrument. We therefore crave for your assistance in validating the instrument. The completion of the form serves as evidence that the student actually validated the instrument

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Educational Techno

Thanks for your anticipated assistance.

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ATTESTATION SECTION

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION DEPARTMENT OF EDUCATIONAL TECHNOLOGY

Dear Sir/Madam,

Instrument Validation Form

The bearer is a student of the above named University and Department. She/he is conducting a research and you have been selected as one of those with requisite expertise to validate his/her instrument. Kindly grant him/her all necessary assistance to make the exercise a success.

Your competency and expertise was considered as factors that will serve to improve the quality of his/her research instrument. We therefore crave for your assistance in validating the instrument. The completion of the form serves as evidence that the student actually validated the instrument

Educational Techno.

Thanks for your anticipated assistance.

Dr ALABI THOMAS ONOTAPO DE 29 1212

Head of Department (Signature, Date & Official Stamp) Student's Surname. A.J. C. Other Names. DA MILOLA Registration Number! M. C. H. BST. C. P. A. Programme. ANTECC H. Title of the Instrument. B. D. S. Y. A. Children Tech ATTESTATION SECTION

Summary of the Remark on the Instrument. Avers all the appeduie of Cognitive domain levels, hence very degrate as an instrument for conduction of research study. I hereby attest that the above named student brought his instrument for validation

Name of Attester. <u>EK. L. L. KWIA</u> Designation. <u>S.L.</u> Name and Address of Institution. <u>FWT</u>, <u>MUNDA</u>

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION DEPARTMENT OF EDUCATIONAL TECHNOLOGY

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA. SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION DEPARTMENT OF EDUCATIONAL TECHNOLOGY

QUESTIONNAIRE ON STUDENTS' ATTITUDE TOWARDS BIOLOGY USING (E-BOOK). Bullosy e-books Altitude Quesponner

Dear Respondent, this questionnaire is designed to elicit your responses on the above subject matter. Any information given will be used purposely for research and will be treated with utmost confidentiality.

SECTION A

Please kindly give accurate responses to the following information by filling in the blank space and ticking (\checkmark) appropriately.

Name of Institution:

Female:

SECTION B

This part of the questionnaire is based on the students' attitude towards E-books. You ticking are requested to either agree or disagree with each statement. If you strongly agree (SA), Agree with the statement tick (SA), if you agree with the statement, tick (A). If you (Λ) , $\eta \in \mathcal{A}$ disagree, tick (D) and if you strongly disagree (SD). Dispre(1)

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S/No	Items	SA	Α	D	SD	(5
	RISLURM	(4)	(3)	(2)	(1)	
1	I believe that using E-books is very effective.					
2	I feel that using E-books is a good innovation.					
3	I like to use E-book for my academic work.					
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Thanks

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APPENDIX F

CRONBACH'S ALPHA RELIABILITY COEFFICIENT FOR QUESTIONNAIRE

SPSS Output:

Case Processing Summary

		Ν	%
Cases	Valid	15	100.0
	Excluded ^a	0	.0
	Total	15	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items			
0.74	10			