IMPACT OF COMPUTER-AIDED INSTRUCTION AND ENRICHED LECTURE METHOD ON INTEREST AND PERFORMANCE IN PHYSICS AMONG SECONDARY SCHOOL STUDENTS, ZARIA-NIGERIA

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE AWARD OF THE DEGREE OF MASTERS IN

SCIENCE EDUCATION
DEPARTMENT OF SCIENCE EDUCATION,
FACULTY OF EDUCATION,
AHMADU BELLO UNIVERSITY,
ZARIA-NIGERIA

DECLARATION

I declare that the work in this thesis entitled “Impact of Computer-Aided Instruction and Enriched Lecture Method on Interest and Performance in Physics among Secondary School Students, Zaria Nigeria ” has been carried out by me in the Department of Science Education, Faculty of Education, Ahmadu Bello University,Zaria. The information derived from other literature were duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any institution.

_____	_____	_____
Musa BELLO	Signature	Date

CERTIFICATION

This thesis entitled **"**IMPACT OF COMPUTER-AIDED INSTRUCTION AND ENRICHED LECTURE METHOD ON INTEREST AND PERFORMANCE IN PHYSICS AMONG SECONDARY SCHOOL STUDENTS, ZARIA NIGERIA " by Musa BELLO meets the regulations governing the award of degree of Masters in Science Education of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

_____ _____

Dr. M.M. Atadoga Date
Chairperson, Supervisory Committee

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Dr. S.S. Obeka (Very Rev.) Date
Member, Supervisory Committee

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Head of Department

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Prof. K. Bala Date
Dean, School of Postgraduate Studies

DEDICATION

This thesis is dedicated to my father, Salihu Ladan Bello, and mother, Habiba Ladan Bello, my beloved wife Amara, my children Zaharadeen, Imran, Fai'za Ramlatu and the entire family of Musa Bello

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OPERATIONAL DEFINITIONS OF TERMS

The following terms have been used to suit this study

- **Academic Performance:** The level of performance in the subject as exhibited by an individual
- **Availability:** Presence of Computer-Aided Instructional materials for teaching physics and learning based on teacher-student ratio prescribed by the National Policy on Education (FRN,2004).
- **Computer Aided Instruction:** Encompasses computer and telecommunication concerned with the instruction used in handling, acquiring, processing, storing and dissemination of information.
- **Interest:** Attraction which forces or compels one to respond to a particular stimulus
- **Laboratory Facilities:** These are facilities used in physics laboratory for the purpose of teaching students and conducting experiments.
- **Enriched Lecture Method:** A teaching method regarded as traditional method of teaching in an educational institutions involving integrating laboratory facilities in teaching wave concept
- **Multimedia:** A term used in science education referring to materials on both CD Rom and available on the internet series of books and audio cassette a television or video programme text, pictures, sound, animation and video, organized into some coherent programme.
- **Physics:** A science subject that is concerned mainly with matter as it relates to energy.
- **Projected Media:** These are media that use source of power.

LIST OF FIGURES

ABBREVIATION

CAI	Computer-Aided Instruction
NAEP	National Assessment of Educational Progress
NECO	National Examination Council
NETC	National Educational Instruction Centre
NTI	National Teachers Institute
PISA	Programme for International Student Assessment
WPT	Wave Performance Test
WIIQ	Wave Interest Inventory Questionnaire
SSCE	Senior Secondary School Certificate Examination
WAEC	West African Examination Council
ACAILFQ	Avalability of Computer-Assisted Instruction Lboratory Facilities Questionnaire

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ABSTRACT

This study examined the Impact of Computer-Aided Instruction and Enriched Lecture Method on Interest and Performance in Physics among Secondary School Students, Zaria Nigeria. The study developed five research objectives among which included the determination of the impact of Computer-Aided Instruction and Laboratory Facilities on interest and academic performance of students exposed to wave concept of physics in Senior Secondary Schools of the study area. The study was guided by five Research Questions and four null hypotheses. Two research designs: namely, Survey and Quasi-experimental-control group designs involving pre-and post-tests were used in this study. The population of this study covered all public Senior Secondary Schools with population of one thousand six hundred and ninety six (1,696) year II physics students as at 2014/15 academic session out of which a total number of 198 SS II students were sampled from three public Senior Secondary Schools of Zaria education zone selected using systematic sampling technique. Three validated instruments developed by the researcher namely; Availability of Computer-Aided Instruction and Laboratory Facilities Questionnaire, Wave Performance Test and Wave Interest Inventory Questionnaire with reliability coefficients of 0.8, 0.7 and 0.9 respectively were used for the study. Research Questions raised were answered using means and standard deviations, while null hypotheses were tested with inferential statistics using t-test and Analysis of Varience at 0.05 level of significance. Results of finding showed that there is significant difference between the mean academic performance of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method in favour of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method groups. Also, there is significant difference between the interest of physics students' taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and Lecture Method at Senior Secondary Schools of the study area. Similarly, the findings revealed no significant difference between the mean academic performance scores of male and female students taught wave concept of Physics using Computer-Aided Instruction and those taught the same concept using Lecture Method only at Senior Secondary Schools of the study area. The study recommended for the need of state government to train and retrain teachers on the use of Computer-Aided Instruction in teaching physics at Secondary School level.

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CHAPTER ONE

THE PROBLEM

1.1. Introduction

Physics is one of the science subjects taught at senior secondary and tertiary levels of education in Nigeria. It is defined as that branch of science which is concerned with fundamental ideas about nature and attempts to establish relationships between different quantities as precise as possible. According to Okpala,(2001), physics is a physical science subject that is concerned mainly with matter as it relates to energy. The subject also deals with the study of laws that determine the structure of the universe with reference to the matter and energy in the universe (Ike, 2002). Physics is the most utilized basic science subject in most instruction and instruction-related professions. It is based on this that the Federal Government of Nigeria (FRN, 2013) placed the subject as one of the core subjects that each science student must be exposed to at Senior Secondary School level as stipulated in the National Policy on Education..

The importance of Physics for the development of a nation can not be over emphasized. As noted by Josiah (2012), the knowledge of physics facilitates the understanding of other disciplines: Physics is also a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water, energy, and information instruction. For instance, understanding of Physics is quite necessary for developing new instrumentation and techniques in the health sector: With the help of medical physics, the right equipment for the diagnosis of diseases and the efficient communication of medical data are acquired.

Adeyemo (2010) added that Physics is a unique subject, which promotes the acquisition of specialized science skills and knowledge, which explain the natural phenomena of life in the society. It is a subject that grew up with civilization as man's

quantitative needs increased. It has contributed to the development of the sciences and to the development of civilization.

The study of Physics enables learners and practitioners in the field to understand the changing and existing world. Physics as a school Subject helps to make sense of the universe and that is why physicists are always developing theories to describe the physical world, checking these theories for in consistencies, experiments to test these theories, making predictions on the basic of the experiments and progressing to apply the new knowledge for a better understanding of the universe (STAN,1990).

In studying Physics, students acquire the knowledge and the skills to understand how and why natural things happen the way they do; to make predions and venture into unknown areas of knowledge and more importantly using the knowledge and skills to design and make new things. Physics is the study of events in the universe (both remote and immediate universe). A physicist looks at the matter making up the universe, the motion and energy of matter, the cause effect relationship of matter and energy, and the application of natural phenomena.

Despite all these benefits, reports by the Nations Examination bodies (WAEC and NECO) indicated that students' performance in the subject is relatively poor over the years. Performance of students in the subject at secondary scchool level in the country has been a matter of concern to various people and government at various times (West African Examination Council, WAEC, 2013). According to WAEC (2013), candidates that offered physics performed poorly in the areas of understanding of the concepts of waves, sound, Electrolysis, writing of formulae as well as explanation of basic principles, concepts and their applications. Physics is one of the subjects in which the students' performance at the SSCE level has remained persistently low in recent time, (WAEC, 2013). The poor performance of students in Physics at SSCE is attributed to a

number of factors ranging from teachers' attitude, the learners' attitude, and the curriculum, method of instruction and instructional materials, mathematical deficiency among others.

According to previous studies, (Resnick, 1989, Okeke, 1995 & Josiah, 2012), a lot of factors like utilization of inappropriate teaching methods in schools, poor quality school science teachers, lack of enough teaching facilities and school location attributed to students' poor performance in physics. Onyeka, Nneka and Augusta (2012) attributed poor performance to inadequate qualified teachers, equipment, poor attitude of students and poor understanding of the concepts due to their abstract in nature. It had been reported that a problem confronting Physics students in Nigeria is that some of the teachers are not qualified as such unfamiliar with the names and use of some science equipments and facilities (Akpan, 2006).

As the educational sector is faced with series of changes and reforms in Nigeria and other developing countries, and as Nigerian government place higher emphasis in achieving millennium development goals (MDGs) by 2020 through science and instruction, it is good to reflect on matters concerned with physics and the dissemination of physics knowledge and lessons. To ensure this, several strategies for teaching physics have been developed which correspond to the accommodation of students' need and diverse learning method.These teaching methods range from Demonstration, Project, Group Work, Cooperative Learning, Expository, Inquiry, Discussion, multimedia-technique, Field-Trip, Questioning-Technique, Simulation, Experimental, Team teaching, Verbal Instruction, Lecture method, Bainstorming, Problem Solving, Role playing and Drama, Filmed Taped,Individualised, Use of Fiction and Use of Local Resources (Akinyemi, 1997, Akpan, 2001, Obeka 2010 & Josiah 2012). This study will

focus on the use of Computer-Aided Instruction and Laboratory Facilities in teaching Physics.

Computer-Aided Instruction is any instruction used in producing, organizing and passing information to students. Computer-Aided Instruction encompasses computer and telecommunication. It is concerned with the instruction used in handling, acquiring, processing, storing and dissemination of information. Similarly, in educational term, Computer-Aided Instruction can be understood as the application of digital equipment to all aspects of teaching and learning (Adeyemo, 2010).

According to World Bank, Computer-Aided Instruction consists of the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information; the use of Computer-Aided Instruction, as stated by Adeyemo, (2010), falls into four (4) major categories; constructing knowledge and problem solving (through the internet-mail, CD-ROMs, databases, videoconferencing); using process skills; aiding explanation of concepts; and communicating ideas.

The use of Computer-Aided Instruction in teaching is a relevant and functional way of providing education to learners that will assist in imbibing in them the required capacity for the world of work. Very few jobs today do not require the use of skills in instruction, collaboration, teamwork, and information; all of these can be acquired through teaching with Computer-Aided Instruction. It fundamentally changes the way we live, learn and work. Though tried with other science subjects, the use of the Computer-Aided Instruction (CAI) is not common in Physics especially at the Senior Secondary Certificate Examination (SSCE) level which is the focus of this study. The Computer is an electronic device used for executing precisely stated rules with accuracy, rapidity and with real reliability. According to Unongo (2009), computer is capable of making calculation, storing information in various fields of study, designing devices, and making

graphical representation of engineering parts and providing leisure in form of music. Studies have also shown that computer self-efficacy has a positive effect on information literacy self-efficacy. Tuncer (2013) and Inci, John, Nilgun and Ozge (2006) all found the use of the computer in teaching to facilitate performance in Physics and other sciences. However, integration of ICT into education system in Nigeria is poor.

Instruction has entered the classroom and become part of the teaching and learning processes. However, teaching physics as a science oriented course is known for its abstract nature. Sometimes the physics teachers do not have adequate knowledge, but have to fall on ideas which lead to contradictions with what the physics theory says or meant. Students are left on their own, even when they are to read on their own, they find no material to read, where it is available most of them are obsolete material. That is, some of these materials include text book, journals, research publications and news papers. Where these materials are lacking, the students are forced to loose interest, motivation and passion; in some cases frustration sets in and students abandon the discipline or subject matter (physics) for another which they can cope with i.e. students leaving science class because of physics to Commercial or Art subjects, simply point to the fact that other disciplines are not abstract in nature like that of physics.

Similarly, Busari (2006) ascertained that the whole world is experiencing the advancement of science and instruction. Each nation is either a powerful producer of instruction or a consumer of other nation's instruction efforts. In fact instruction has made the whole world a global village and Computer-Aided Instruction breakthrough has made a new landmark in globalizing education. The use of Computer-Aided Instruction is fast gaining prominence and becoming one of the most important elements defining the basic competencies of the students.

Despite the abstract nature of physics, its teaching is to bring about scientific thinking in students; a mindset that requires students to test out, through experimentation. However, through the use of Computer-Aided Instruction, whether CD-Rom, power point, among others. A number of studies have been made on Computer-Aided Instruction such as instructional radio, television, computers among others, and result shows that it is an effective media for imparting knowledge to the learners. For example, Wubbles, Brekelmans and Hoomayers (1991) opined that educational radio provides listening, participation, effective means of presenting studies, team teaching and increasing student's performance.

Educational Television is another Computer-Aided Instruction facility in teaching physics and it was recognized as a vital medium for education, information and socialization. Some studies have been done on television as an effective instructional media.For instance, Brown (1995) indicated that students remember only 10% of what they read, and about 20% of what they learned and 50% of what they hear and see. This indicates that television has the potentiality of performing this task but when effectively and correctly utilized by the teachers and learners.

Laboratory has been conceptualized as a room or a building specially built for teaching by demonstration of theoretical phenomenum into practical terms (Farombi, 1998). Laboratory is essential to the teaching of sciences and the success of any science course is much dependent on the laboratory provision made for it. It could be described as a place where theoretical work is practicalized whereas practicals in any learning experience involves students in activities such as observing, counting, measuring, experimenting, recording observation and carrying out field work. Laboratory helps to provide a forum wherein the learner is given the exercise to subjects, his beliefs, ideas, statements and theoretical propositions. to some forms of experimental test (Soyibo, &

Nyong 1984). To maintain and arouse the interests of students in subjects involving laboratory work, the teacher should be effectively involved in order to transfer knowledge and facts to learners for a good performance in any examinations. In line with this, one then pauses to ask: To what extent has Laboratory Facilities are available in our science laboratories to achieve its objectives?

Writing on the situation of our secondary schools today, Okoli (1995) reported that laboratories have become shelves of empty bottles of chemicals. In terms of academic performance, Soyibo and Nyong (1984) have shown that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are ill-equipped. Yadar (2007) opined that no course in science and mathematics can be considered as complete without including some practical work. Owoeye and Yara (2011) investigated the provision of Laboratory Facilities as it relates to Academic Performance of students in agricultural science in Ekiti state of Nigeria between 1990 and 1997, the results showed that there were no significant differences in the performance of students between rural and urban secondary schools in term of availability of laboratory facilities.

Interest is another variable in this study. It is a feeling of curiosity or concerned about subject that makes the attention turn towards it. Okafor (2000), described interest as the attraction which forces or compels a child to respond to a particular stimulus. Obeka (2009), views interest as the course of certain actions which acts as drive that propel student to act in certain ways. It is a type of attitude when share in some characteristics of cognitive, affective and psychomotor components. Aggarwal (2008), is of the opinion that interest is a feeling that prompts individual to impulsive acts. It is an inspiring vigor that impels student to attend to an activity as well as effective experience that has been stimulated by the activity itself. Research report (Okafor, 2000) shows that

due to abstract nature of physics, students developed negative interest towards it. This may affect their performance in the final year examination. It is against this background that this research was conducted to determine the impact of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on academic performance and interest of students in waves concept of senior secondary physics students.

1.1.1 Theoretical Framework

This study is based on constructivism, which is associated with the work of Piaget (1980) and Bruner, (1960). Piaget talked about the developmental stages of learning of concepts and this sudy used the students of average age of 17 and above. For the purpose of this study, Bruner's model of teaching learning of concepts served as theoretical framewok. According to Bruner, (1960), constructivism is a theory of learning that individuals create their own new understandings on the basis of interaction between what they already know and believe and ideas and knowledge with which they come into contact and based on prior experiences. The constructivist perspective holds that meaningful learning or understanding is constructed in the internal world of the learner as a result of his or her sensory experiences with the world. The teacher in the classroom serves as a guide or facilitator.

The concept of learning by doing is a psychological concept that implies allowing students to learn by doing within the classroom context is a departure from traditional methods. The scholar further reitretes that concept learning involves deliverate introduction of certain concepts and sub-concepts in order to enhance meaningful learning and retention of the learning materials perceived difficult to leraners. The introductions of materials are meant to provide pre-requisite knowledge that will assist the learners to understand a specific concept.

Bruner (1960) proposed the subsumption model of learning which is based on prior knowledge and is used for intepretation of new information to be learned. Thus, he proposed the idea that meaningful learning takes place only when a general subsuming concept is available in learners' cognitive structure and that such idiosyncratic concepts are usually derived from currently held concepts. According to Bruner (1960), the requisite advance organiser can be used when no anchoring idea are available to the learners. That is,when new learning material is unfamiliar to the learner. Bruner ascerted that; for any meaningful learning to take place, new materials to be learnt must be carefully linked to the the learners'prior knowledge, otherwise rote learning will take place. The scholar suggested that development occurs as mental structures become more elaborate and sophisticated through interaction and experience: learners construct new ideas or concepts based upon their prio knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. In this study, Bruner's model of learning by doing is adopted as a theoretical framework for the study.

1.2. Statement of the Problem

Research reports and available literatures over the years (West African Examination Council,WAEC, 2013) revealed that poor performance among senior secondary students in Senior Secondary School Certificate Examination (SSCE) Physics still persist. According to the released result for 2011 examination, the National Examination Council (NECO, 2012) has recorded mass failure in the November/December Senior Secondary School Certificate Examination (SSCE) in science subjects. Only 10 percent of the candidates that sat for the examination scored credit and above in the core subjects such as English Language, Biology, Chemistry, Geography and Physics (Bello, 2012). The WAEC Chief Examiners' reports betwen

2008 and 2013 also revealed that students' performance in Physics examination is becoming low. The report shows that in 2008, a total number of 1330 students registered for physics exam out of which 20.5% were able to pass at credit level while 79.5% failed. In 2009 the percentage of failure was 69%, and 70% in 2010. The rate of failure increseaded to 73% in, 2011,75.4% in 2012 and 76% in 2013. According to previous studies, poor performance in physics has been attributed to insufficient man power, equipment, and poor attitudinal interest of students, poor understanding of the concepts due to their abstract nature resulting to errors in practicals.and such problem has been traced to lack of appropriate teaching method, laboratory facilities, equipments and apparatus. Means of communicating science to learners by teachers must be pursued so as to achieve the desirable goal through an effective methodology for any concept, such as the use of Computer-Aided Instruction and laboratory facilities.

Investigations reveal that many students at the senior secondary school in Nigeria strongly detest the manners in which the physics teachers handle and deliver physics knowledge and lessons. (Adeyemo,2010). Research report (Busari 2006 & Adeyemo, 2010) further indicated that Computer-Aided Instruction facilities in secondary schools of Nigeria are inadequate. Where there is availability of such materials, their usage become very difficult or impossible. Factors identified among researchers are the class-size poor reading skills of science and instruction students, the state of laboratory and Computer-Aided Instruction facilities, methods of teaching and learning of science subjects among others. The problem of this study therefore hinges on what is the impact of Computer-Aided Instruction and Laboratory Facilities on physics students'academic performance in wave concept at Senior Secondary level in Zaria Education Zone?

1.3. Objectives of the Study

The objectives of this study are; to:

1. determine the availability of Computer-Aided Instruction and laboratory facilities for teaching physics in Senior Secondary Schools of the study area.
2. assess the impact of Computer-Aided Instruction and Laboratory Facilities on the academic performance of students exposed to wave concept of physics in Senior Secondary Schools of the study area.
3. examine the impact of Computer-Aided Instruction, Laboratory Facilities and Enriched Lecture Method on students' interest in wave concept of physics in Senior Secondary Schools of the study area.
4. assess the impact of Computer-Aided Instruction and Laboratory Facilities on male and female students' academic performance exposed to wave concept of senior secondary school physics.
5. examine the impact of Lecture Method on academic performance of male and female students exposed to wave concept of senior secondary school physics.

1.4. Research Questions

The following Research Questions are framed for answering;

1. What is the state of availability of Computer-Aided Instruction and Laboratory Facilities for teaching physics at Secondary Schools of Zaria?
2. What is the difference in the mean academic performance scores of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities and those taught the same concept using Lecture Method?
3. What is the difference in the mean interest of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities and those exposed to Lecture Method in Senior Secondary Schools?

4. What is the diference in the impact of Computer-Aided Instruction and Laboratory Facilities on male and female student's academic performance when taught wave concept of physics at Senior Secondary Schools?
5. What is the difference in the mean academic performance scores of male and female students' taught wave concept of physics using Lecture Method ín Senior Secondary Schools?

1.5. Null Hypotheses

The following null hypotheses are formulated and tested at $p \leq 0.05$ levels of significance.

H_{01}: There is no significant difference between the mean academic scores of students taught wave concepts using Computer-Aided Instruction and Laboratory Facilities and those taught the same concept using Lecture Method.

H_{O2}: There is no significant difference in the interest of physics students' taught wave concepts using Computer-Aided Instruction and Laboratory Facilities and Lecture Method at Senior Secondary Schools.

H_{O3}: There is no significant difference between the mean academic performance scores of male and female students' taught wave concept of Physics using Computer-Aided Instruction and those taught the same concept using Lecture Method only at Senior Secondary Schools.

H_{O4}: There is no significant difference between the mean academic performance scores of male and female students' taught wave concept of Physics using laboratory facilities and those taught the same concept using Lecture Method only at Senior Secondary Schools.

1.6. Significance of the Study

The findings of this study will hopely be significant to teachers, students, textbook authors, other researchers and curriculum planners in the following ways:

- The finding of this might motivate physics teachers to source the appropriate Computer-Aided Instruction and Laboratory Facilities through request from the concerned authority, tertiary institutions as well as improvised were necessary for teaching the subject.
- Aid in the attainment of national objectives of secondary education especially in the improvement of students' performance in physics examination. According to FRN (2013), the National Aims and Objectives of Education in Nigeria are: The inculcation of National consciousness and National unity; The inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society; The training of the mind in the understanding of the world around us; and; The acquisition of appropriate skills, abilities, and competences both mental and physical as equipment for the individual to live in and contribute to the development of his society.
- Text book authors might found the study very useful and use the outcomes in publishing physics textbooks for secondary schools which consequently expand the frontier of knowledge.
- Other researchers undertaking similar studies in this field may use the outcomes of this study as a source of literature of their study and build upon it.
- Curriculum planners such as NAERDC can use the outcomes of this study, design and include programmes in the physics curriculum that are in line with Computer-Aided Instruction and Laboratory Facilities to aid meaningful learning in our schools.

- Professional development bodies such as STAN will utilise the outcomes of this study and organise seminars, workshops, Conference and in-house training to physics and other science related teachers on effective used of Computer-Aided Instruction and Laboratory Facilities in teaching.

1.7. Scope of the Study

The research examined the Impact of Computer-Aided Instruction and Enriched Lecture Method on Interest and Performance in Physics among Secondary School Students in Zaria education zone, Kaduna State. Senior Secondary (SSII) students were used for this purpose. The justification behind the use of SSII students rests on the fact that students at this level are perceived most suitable for research of this nature. They are neither introductory SSI students engaging in registration, accomodation,busy to be acquinted with the environment nor final year, SSIII students deeply concentrating on mock and final year examinations. The research were delimited to only public Senior Secondary Schools offering physics in Zaria education zone. The characteristics nature of these students are publically owned, average age of 17 years and coeducational.

Wave concepts drawn from SSII syllabus were used as a content for teaching experimental and control groups. The concept of waves treated in this study are;

1. definition of waves
2. type of waves; (transverse, longitudinal, stationary waves)
3. wave theories;
4. applicaton of waves; and;
5. simple calculations in wave concept.

The use of this concept can be justified based on the fact that physics curriculum emphasised its teaching at SSII level and that most of the concepts of wave are abstract in nature having limited instructional facilities (Adeyemo, 2010). According to WAEC

(2013) Chief examiner reported that these concepts appeared annually in the SSCE and perceived by students as difficult concepts that yield in their failure.

The Computer-Aided Instruction and Laboratory Facilities which this study seeks to determine their impact are; instructional television; instructional radio; computer; projectors; internet facilities; and; compact disk. The justification behind the choice of these facilities is their accessibility and affordability and un-fragile nature for use in our schools. Such facilities were prescribed to be available in school but are kept for other purposes other than physics teaching. The time extent for the study lasted for six weeks.

1.8. Basic Assumptions

In carrying out this study, the researcher assumed that:

1. Teachers employ variety of instructional strategies in teaching physics.
2. Classroom environment in the study area is conducive enough in facilitating effective teaching with Computer-Aided Instruction and Laboratory Facilities and Lecture Method.

CHAPTER TWO
REVIEW OF THE RELATED LITERATURE

2.1 Introduction

This study examined the impact of Computer-Aided Instruction and Laboratory Facilities on interest and academic performance in wave concept of physics students at Senior Secondary School level in Zaria education zone, Kaduna State. In this chapter, the literature is reviewed under the following sub-topics:

- Concept of Physics as a School Science Subject.
- Methods of Teaching Physics at the Senior Secondary School Level.
- Computer-Aided Instruction in Science Education.
- Impact of Computer-Aided Instruction in Teaching.
- Laboratory Facilities and Academic Performance.
- Curriculum Implication of Computer-Aided Instruction.
- Challenges of Curriculum Implementation.
- Lecture Method.
- Interest and Academic Performance in Science Education.
- Gender and Academic Performance in Science Education.
- Overview of Similar Studies.
- Implications of the Review to the Present Study.

2.2. Concept of Physics as a School Science Subject

Physics is a science that deals with the structure of matter and the interactions between the fundamental constituents of the observable universe. In the broadest sense, physics (from the Greek physikos) is concerned with all aspects of nature on both the macroscopic and submicroscopic levels. Its scope of study encompasses not only the

behavior of objects under the action of given forces but also the nature and origin of gravitational, electromagnetic, and nuclear force fields.

Olarinoye (2000) defined Physics as a branch of physical sciences that concerns mainly with matter in relation to energy. Physics, as a science subject, has been acknowledged as a pre-requisite for the study of several courses in the universities. For examples, engineering, medical and other applied science courses need physics. It is the most utilized basic science subject in most instruction and instruction-related professions". According to Ike (2002),Physics deals with the study of laws that determine the structure of the universe with reference to the matter and energy in the universe.Adeyemo(2010), added that Physics is a unique subject which promotes the acquisition of specialized science skills and knowledge, which explain the natural phenomena of life in the society. It is a subject that grew up with civilization as man's quantitative needs increased. It arose out of practical problems and man's need to solve these problems. It has contributed to the development of the sciences and to the development of civilization.

Josiah (2012) posited that the importance of Physics for the development of a nation is, therefore, glaring. Physics as one of the basic sciences, its concepts and techniques strengthen the understanding of all other branches of science. The researcher adds that the knowledge of physics facilitates understanding of other disciplines. Physics is a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water, energy and information instruction. The understanding of Physics is quite necessary for developing new instrumentation and techniques in the health sector. For example, with the help of medical physics, the right equipment for the diagnosis of diseases and the efficient communication of medical data are acquired. Added to that, the Computed Tomography (CT) scanner is a hub for the

development of telemedicine. In developing fixed-line and optical-fiber networks in information instruction, knowledge of the physics that underpin these technologies is essential. Its ultimate objective is the formulation of a few comprehensive principles that bring together and explain all such disparate phenomena. The technological growth of a nation, as noted by Josiah (2012), leads to its social and economic development. Thus, the discipline of physics is a gate way to such developments. In this study wave concept is used as a physics concept exposed to experimental and control groups.

2.3. Methods of Teaching Physics at the Senior Secondary School Level.

The term "method" refers to the ways, approaches, procedures and kinds of activities which teachers and students engage in the interactive process with a view to inducing, inspiring and facilitating learning for the purpose of accomplishing a set of instructional objectives (Joshi, 2008). Methods also include utilization of appropriately selected curriculum materials, content and learning experiences, motivational strategies, an application of learning theories and a demonstration of knowledge of developmental psychology or other aspects of educational psychology in the teaching learning process.

There have been a variety of methods and techniques for teaching the sciences. These methods range from Lecture Method (Abdullahi, 2009), inquiry method (Obek,2010), laboratory (Mari, & Tongding 2010 & Usman, 2010), demonstration (Obeka, 2010), discussion method (Atadoga & Lakpini, 2013), Questioning Technique method,(Akinyemi, 1997, Akpan, 2001,& Josiah 2012) among others.

Simulation method is a userful teaching strategy illustrating a complex and changing situation. Simulations are (necessarily) less complex than the situations they represent. In a simulation, the learner acts, the simulation reacts, the learner learns from this feedback. Note that in each case the game involves rules and the students must take decision. Each decision a student makes affects the outcomes of the game. The students

participate in the game, playing their roles as assigned (Abdullahi, 2009). On the other hand, experimental method is usually taken to be the most scientific of all methods, the limited of choice. The main problem with all the non-experimental methods is lack of control over the situation. The experimental method is a means of trying to overcome this problem. The experimental is sometimes described as the cornerstone of psychology. This is partly due to the central role experiments play in many of the physical sciences and also to psychology's historical view of itself as a science. A considerable amount of psychological research uses the experimental method. An experimental is a study of cause and effect. It differs from non-experimental methods in that it involves the deliberate predictions.

Obeka,(2010) sees Inquiry method as a term used broadly to refer to everything from pscudo-experiments where the teacher has the students reify already taught concepts to one in which students have virtually total control. The parts of a lesson should match the different components of laboratory report usually, the first part written (or discusses in class) is the problem or question.

Abdullahi, (2009) noted that Verbal instruction is the commonest method of teaching and is used at all levels. It involves the systematic presentation of informations or instructions through oral exposition by the teacher, supplemented by the use of appropriate teaching aids or instructional materials. At school level it is often refered to as chalk and talk teachers who have very few teaching aids or materials, including books have to rely heavily on this method. In this method, informations or explanations they have to give should be quite clear, expressed language which their pupils can readily understand, and presented in an interesting and systematic way.

According to Akinyemi, (1997), Brainstorming is realy an advanced use of the discussion method and involves co-operative thinking by groups towards the solution of

a specific problem. It purpose is simulation and generation of ideas in the pupuls and facilitation of their expression. This provides an exercise in critical evaluation for pupils and teacher. The method is suitable only for older pupils in secondary schools or students and colleges and universities who can think on their own with little guidance from the teacher.

Akpan, (2001), and Josiah (2012) opined that Problem solving method requires the ability to reason and demands active thinking on the part of the leaners. The teacher's task is to select suitable problems, which are within their capacity to solve, and in some cases to suggest methods of procedure or provide suitable materials. But he will not teach them exactly what to do, though they will often rely on using methods which he has previously taught. Problem-solving develops reflective thinking, creative expression, critical analysis, and logical reasoning in the pupils, and provides valuable carry-over benefits of application to future individual and group problems. The method is suitable for use in primary, secondary and terciary classes.

Okam (2009), noted that Individualised method is a style of individualized writing instruction that enables students to learn at their own pace for example, writer's workshop is a child-centered method of teaching writing skills. It teaches students how to write for the view of the reader, and for the purpose of self development, logical presentation of ideas and shearing the author's view point for interaction and scholarship. This allows for individualized lessons for every ability level, including gifted and slow learners. Writers workshop, project writing skills and independent class assignment which task teacher/students independent work art notable examples. This method of instruction is most suitable for advanced scholarly worked and for research purposes. Individualized role play, student or teacher centered activity to achieved specific task

may be refered top as individualized instruction in a loose sense to achieve set instructional goals.

Uses of local resources, many teachers and group leaders have worked together with local institutions or organizations to help broaden their students' experiences. In addition, some have had success finding corporate sponsors who can donate time, materials, or money for the groups' activities. Local resources are those environmental resources, features or man design/structure commonly used for instruction, tourism, and for other reaction purposes. Example are: Natural history and science museums, Bird/raptor rehabilatators and zoos, local bird clubs and societies, Art museums, Public libraries, Specialised lab, and Local newspapers.

Another method of teaching is Demonstration method (Abdullahi, 2009). This is a method of teaching in which sight rather than hearing is the major means of communication,though of course the two are often combined. It is effective because most people more easily remember what they see than what they only hear or read. At its simplest, it may involve only showing an actual object, model, picture or diagram. Demonstration, however, usually involves a process in which the learner has to follow a number of steps. No meaningful teaching and learning can take place without adequate instructional strategy.

For this study, computer Assisted Instruction and the use of Laboratory Facilities were used in teaching the experimental groups while lecture method was used in teaching the control group and were discussed under the following sub-themes. However, there is a need to review some literatures on multi-media in teaching as it relates to computer Assisted Instruction and the use of Laboratory Facilities.

Multimedia is a term used in science education referring to materials on both CD Rom and available on the internet. It then means to be applied to multiple media in such as a series of books and audio cassette tied to a television or video programme. This assertion was in line with Philip (1990) who characterized multimedia by the presence of text, picures, sound, animation and video, some or all of which are organized into some coherent programme. Scholars (Onyejomezie,1981; Philip, 1990; Kumar, 2008) viewed the term multimedia to mean the same with teaching aids,instructional instruction, conventional materials, curriculum materials or learning aids.However, differences in the use of terminologies to describe multimedia do not account too much so as to make it loose its central meaning or information.

Abdullahi (2009), sees multi- media as a wide range of materials providing realistic image for enriching curricular contents and consequently enhancing educational process. He stressed that instructional materials include; simple things living and non livings in the immediate environment like stones, leaves, chalk board; printed materials, charts, maps, models; real objects; and sophisticated things, audio and video machines, projection machines and computers. Multimedia can be in form of: still media, audio materials, filmed materials, projected materials and television, audio materials (Radio), visual material (still media), audio-visual materials (television), among others.

Multimedia are powerful tools for making presentations.They offer unique advantages in the field of education. For instance, in teaching biology, an instructor cannot make a killer While come alive into class room. Multimedia enables us to provide a way by which learners can experience their subject in a vicarious manner. Multimedia can be in form of Computer Assisted Instruction,Television,radio, Cameras,tape recorders, slide, among others.

The use of multimedia in the classroom is very important in providing opportunities for students to learn visualized concepts effectively. Several studies (Famwang, 1996;Roger, 1999; Yalland, 2001; Abdullahi, 2009; Josiah, 2012) argued that the use of new technologies in the classroom is essential for providing opportunities for students to learn, operate in an information ages. It is evident as Yalland (2001) argued, that traditional educational environment does not seem to function or be productive in the work places of today's society.In the teaching and learning of Physics, scholars (Yalland, 2001; Abdullahi, 2009; Kumar, 2008) recommend the use of the following media:

1. Projected Media: These are media that use source of power for generating them. They include, over head projector (OHP), slide projector, opaque projector and the most recent is the computer power point. In fact, these media can be used advisably to teach large class for their cost-effectiveness.
2. Chalkboard: This may be movable, fixed or portable ones. The fixed or removable chalkboard is usually found in a typical classroom, while the teacher usually produces the portable chalkboard that she/he can move around. However, chalkboard of any type is mostly used for illustration, clarity of points or concepts and to summarize the content taught.
3. Printed Media: These include: textbooks, magazines, periodical, reports, paper cuttings can be consulted or utilized by both teacher and learners in the teaching and learning of physics.
4. Models: These are three-dimensional media that show the length, breadth and height of the objects. They are very useful in the teaching of physics. With the use of models, the lesson becomes real, practical and exciting because the learners can visualize, feel and observe in real life how these features exist.

The Federal Government of Nigeria (FRN, 2013) in its determination to enhance an effective educational programme through the use of educational media stipulates the setting of an educational instruction center as a place where instructional Media are planned, designed, produced and made available to schools. Also it is a place where teaching and learning resources can be stored, used and borrowed for classroom instruction or for independent studies.

The institutions established to carry out such functions are:

- The National Educational Technology Centre (NETC) located in Ibadan.
- The National Teachers Institute (NTI) located in Kaduna
- Educational Instruction Centers in the universities and colleges of Education
- The state Educational Resources Centers across the 36 states and FCT, Nigeria.
- Other agencies such as libraries (in the universities and colleges of Education), zoos and museum (in the recreational centers across the 36 states and FCT, Nigeria), international organizations and agencies.

For the purpose of this study, computer-aided instruction, laboratory and lecture method were reviewed.

2.4 Computer-Aided Instruction in Science Education.

Computer-Aided Instruction are synanoumous with Infomation Communication Instruction and encompass computer and telecommunication which is concerned with the instruction used in handling, acquiring, processing, storing and dissemination of information (Unongo, 2006; Adeyemo, 2010). The researchers added that Computer-Aided Instruction is any instruction used in producing, organizing and passing information through. Computer-Aided Instruction in education can be understood as the application of digital equipment to all aspects of teaching and learning (Adeyemo, 2010).

Philip (1990) characterized Computer-Aided Instruction as multimedia facility by the presence of text, picures, sound, animation and video, some or all of which are organized into some coherent programme. Computer-Aided Instruction referred to materials on both CD rom and available on the internet. However, in the presence age of instruction, there is a legitimate concern that developing countries have been slow in terms of facilitation of learning among the majority of citizens (Hubert, 2006). The researcher noted that many factors bringing to bear on the adoption of Computer-Aided Instruction in education and contemporary trend in 21st century suggest large scale changes in the way education is planned and delivered as a consequence of the opportunities and availability of Computer-Aided Instruction. Evey, Emmanuel, Joseph, Denis and Asinde (2010) added that the emergence of Computer-Aided Instruction has revolutionized the existence and activities of contemporary man especially in the globalization era.

According to the National Grid for learning, UK government initiatives indicated that teachers must move swiftly to more internets and web based work in schools (Adeyemo, 2010). In similar view, Busari (2006) ascertained that the whole world is experiencing the advancement of science and technology. Each nation is either a powerful producer of instruction or a consumer of other nation's instruction efforts. In fact, instruction has made the whole world a global village and Computer-Aided Instruction breakthrough has made anew landmark in globalizing education. The use of Computer-Aided Instruction is fast gaining prominence and becoming one of the most important elements defining the basic competencies of the students (Adeyemo, 2010).

Scholars, (Akinyemi, 1997; Akpan, 2006; Evey, Emmanuel, et, al, 2010) maintained that Computer-Aided Instruction is innovative device that can carry out such functions as receiving, storing, computing, analyzing, transmitting and retrieving

information presented to them and allowing for one-to-one or group communication among humans. Folorunso, Longe and Ijere (2013) identified Computer-Aided Instruction infrastructure to include internet, World Wide Web (www), Electronic Data Interchange (EDI), Local Area Network (LAN), Wide Area Networks (WAN), Protocols, Content Management and Meta Data Standard (MDS). Computer-Aided Instruction is a powerful tool for making presentations; it offers unique advantages in the field of education. For instance, in teaching Biology, an instructor cannot make a killer Whale come alive into class room. Multimedia enables us to provide a way by which learners can experience their subject in a vicarious manner.

Traditionally, the primary sources for obtaining information would be the encyclopedia generally available in the library. With access to interactive media, the students would collect various textual materials about physical locations on earth through a C-D Rom. In addition, students may be able to copy diagram or the skeleton and muscular structure of an animal. For the students, another advantage of multimedia is that it allows them to work at their own pace and control their learning path, students also learn from infinitely patient tutor and actively pursue learning and receive feed-back.Beside students' use, teachers should find Computer-Aided Instruction of great use in delivering their lessons. For example, a history teacher could use a multimedia CD to create lecture on a non violence movement by using film clipping and audio tapes on Mahatma Gandhi or Martin Luther King. To teachers also, it allows for creative work, it saves time for more challenging topics and increases students' contact time for discussion.

Ibe-Bassey (2000) and Inyang-Abia (2004) noted that media is a continuum between stimulus response learning and cognitive learning to make abstract ideas to reality, concepts and facilitate effective learning. This indicated that Computer-Aided

Instruction is capable of facilitating the collection, preparation, presentation, storage, retrieval, conveyance and dissemination of information. Arinze, Okonkwo and Iwunor (2012), reported that in recent times, there has been intense advocacy both nationally and internationally for the application of Computer-Aided Instruction in teaching and learning process. Udo (2010) observed that the application of Computer-Aided Instruction in the school subjects is to make learners learn better and teachers to teach well, it is not a hindrances to teacher-student relationship. It rather ensures transactional instructional communication where the teacher manages the human materials, time and space to make sure that instructional events occur leading to desirable change in behaviour of students.

The extent and depth of research carried out on any specific Computer-Aided Instruction depends on the amount of value attached to it. There are varieties of Computer-Aided Instruction designed to achieve various purposes. Adeyemo (2010),reported that the National Council of Educational Instruction holds the view that Computer-Aided Instruction facilities such as instructional video, television and film have long been popular subject for research because of its promise for use towards increasing learners performance. In addition, radio though came to take advantage of Federal support for media research, there is little interest in it. Projector is also a good instructional material for teaching and learning at Senior Secondary School Level. Teaching and learning is all about interaction between teachers and learners, Computer-Aided Instruction can play various role in such interactive process. The use of Computer-Aided Instruction, as stated by Adeyemo, (2010), falls into four (4) major categories; constructing knowledge and problem solving (through the internet-mail, CD-ROMs, databases, videoconferencing); using process skills; aiding explanation of concepts; and

communicating ideas. In this study, Computer-Aided Instruction is used in teaching experimental group I**.**

2.4.1 Impact of Computer-Aided Instruction in Teaching

The use of Computer-Aided Instruction in teaching is a relevant and functional way of providing education to learners that will assist in imbibing in them the required capacity for the world of work. Very few jobs today do not require the use of skills in instruction, collaboration, teamwork, and information; all of these can be acquired through teaching with Computer-Aided Instruction. It fundamentally changes the way we live, learn and work. Instruction has entered the classroom in a big way to become part of the teaching and learning process. However, physics as a science oriented course or discipline is known for its abstract nature (Adeyemo, 2010). Physics is a subject which promotes the acquisition of specialized science skills and knowledge, which explain the natural phenomena of life in the society. It is a subject that grew up with civilization as man's quantitative needs increased. It arose out of practical problems and man's need to solve these problems. It has contributed to the development of the sciences and to the development of civilization (Adeyemo, 2010).

Despite the abstract nature of physics, its teaching is to bring about scientific thinking in students; a mindset that requires students to test out through experimentation. However, through the use of Computer-Aided Instruction, whether CD-Rom, power point, among others, the teaching and learning of physics is interesting (Adeyemo, 2010).Physics was adopted as a core science subject in Nigerian secondary schools (FRN,2013). It is a course designed to inculcate in the learners science process skills, laws that determine the structure of the universe with reference to the matter and energy in the universe (Ike,2002). That is why Adeyemo (2010), stated that Physics is a unique subject, which promotes the acquisition of specialized science skills and knowledge,

which explain the natural phenomena of life in the society. It is a subject that grew up with civilization as man's quantitative needs increased. It arose out of practical problems and man's need to solve these problems. It has contributed to the development of the sciences and to the development of civilization.

In a related situation, Ibe-Bassey (2000) observed that radio instruction differs from the conventional method of teaching in which the teacher relies almost entirely on the use of human voice to tell subject contents to learners. Radio instruction uses human voice as well as music and sound effect. Both music and sound effects are enlargement of the audio mode, they get to the brain by means of the auditory sense. Unlike the speech mode, music and sound effects have ways of electrifying human experience to ensure memory, recall, reasoning and remembering as in problem solving. The sound effects are used in radio lesson for the purpose of creating a special impression on the learners in Physics lessons.

Similarly, Inyang-Abia (2004) observed that television instruction appeals to two senses of sight and hearing, which means that two types of signals impinge on the brain of the learners while Physics lesson is in progress. Seeing and hearing at the same time have some positive effects of making deeper impression in the minds of Physics learners (Udo, 2006). The importance of Computer-Aided Instruction cannot be over emphasized, just as Udo (2006) acknowledged that it unites all the capabilities of Computer-Aided Instruction innovations by its multi media approach to presenting Physics instruction stimuli to learners in various forms with full-colour impact at the same time. However, McLain and DiStefano (1995) advised teachers on using internet to do some researches before students are given a task on internet to make sure that the topics chosen is available and is suitable for students. The teachers should have a variety of sites they want their students to explore and should have thoroughly explored the sites themselves.

This makes the teachers to be aware of sites that are useful to Physics teaching and learning to avoid entangling the students with tasks that do not help in the performance of the lessons objectives.

Josiah (2012), posited that the importance of Physics for the development of a nation is, therefore, glaring. It has applications in many sectors of economic development, including health, agriculture, water, energy and information instruction. Computer-Aided Instruction is the embodiment of text, graphics, animation, sound and video clips and it can be easily used in Physics education. A look at existing teaching methods show the widespread use of graphic devices and sound, movement and interactivity on a multi-media CD-ROM. To go one step further into the future, students can be provided with realism by using virtual reality system that transport them into an environment created by the computer that generates three-dimensional realistic scenes with which the students can interact.

Ogu (2003) noted that the introduction of compact disc (CD-ROM) has revolutionalized the way information is stored, retrieved and disseminated. Similar is flash drive. CD-ROMs with Physics contents can equally be used in teaching and learning of Physics topics. A Teacher can obtain educational software with Physics contents from major publishers of books, educational software developers, public domain, shareware packages, computer club, users group and educational institutions that have established Computer-Aided Instruction software production units.

Computer-Aided Instruction has a profound impact in classrooms. It adds complexity to a non-linear system. This complexity needs a major change in organisation. Downes, Tarthur, and Beecher (2001), identified four levels of use of Computer-Aided Instruction In the classroom:

Level 1: Computer-Aided Instruction skills are added into the school programme through a separate Computer-Aided Instruction subject, while teacher practices in other subjects remain unchanged;

Level 2: Computer-Aided Instruction skills are integrated into teachers' daily work with some teachers' pedagogical practices and classroom behaviour remaining the same, while the practices of others change more radically;

Level 3: Computer-Aided Instruction is transformative at the classroom level as it changes content as well as pedagogy (what students learn as well as how they learn it);

Level 4: Computer-Aided Instruction is transformative at the system level leading to changes in the organisational and structural features of schoolling.

Mahmud (2010), observed that internet system gives students access to wide range of information and knowledge about environment, socio-cultural, economic and other aspects of life of the people in various parts of the world. The use of computers as Computer-Aided Instruction in teaching sciences have been advocated by many researchers (Atadoga, 2012; Becta, 2004, Butcher, 2003 & Josiah, 2012). Butcher, (2003), ascertained that computer has dominated human activities especially in the last two decades. Its use is complemented by a whole lot of other electronic devices, all of which are now collectively regarded as Computer-Aided Instruction. Some basic impacts of Computer-Aided Instruction on the teaching process has been identified by scholars as it:

- has an edit effect in terms of quality of students' work and practical examples through visualisation;
- improves poor handwriting and languages skills through word processing;
- equalises individual differences and has particularly dramatic effects for students with special needs;

- facilitates self-pacing with increased capacities to deal with individual learning styles as students can work at the pace and intensity suitable to their needs;
- Enables collaborative learning with little indication of the isolated learner;
- Encourages use of peer coaching and peer reviews;
- Develops communication skills and awareness of different audiences;
- Has impact on resource–based learning and access to real world information through the Web;
- Increases information reliability and accuracy adding to authenticity of learning tasks, with realistic and up-to-date information;
- Increases students' motivation through hands-on activity, visual representations and improved modes of presentation;
- Encourages independent learning and individual preferences for process, layout, style and format;
- Gives students more control;
- Allows students to produce high quality multimedia products;
- Changes teacher practices, planning tools and assessment rubrics;
- Increases opportunities for classes to evolve and for student experiences to shape outcomes;
- Has motivated students to commit to learn and to participate in learning activities;
- Has improved students' quality of work and has given them the confidence to perform enhanced learning tasks;
- Has allowed students to learn independently, which has enabled more work to be completed and

- Has enhanced performance due to the reinforcement and practice that Computer-Aided Instruction has afforded.

Computer-Aided Instruction is a powerful combination of early technologies' that constitutes an extraordinary advancement in the capability of machine to assists the educational process (Gray, 2007) Computer-Aided Instruction combines computer hard ware, software and peripheral equipment to provide a rich mixture of text, graphics, sound, animation, simulations, full-motion video and other devices to convey information to the students effectively. However, students take an active role in learning processes and much more attentive to programmes where animations and narratives are used (Aburime, 2004). Some studies have been done on television as an effective instructional media Brown (1995) indicated that students remembers only 10% of what they read, about 20% of what they learn and 50% of what they hear and see. This indicates that television has the potentiality of performing this task but when effectively and correctly utilized by the teachers and learners. Computer-Aided Instruction has the ability to capture the attention of the learners because it addresses a variety of learning styles.In this study, Computer-Aided Instruction (computer with projector, instructional radio and instructional telvision) were used as treatment for experimental group.

2.5 Laboratory Facilities and Academic Performance

Academic performance of students in science subjects generally had witnessed a deplorable trend in the past decades (Ihuarlam, 2008). Science education at all levels of education in Nigeria is in a deplorable state from the primary, secondary to the tertiary institutions. There is a death in science facilities in the laboratories and this contributes to students' poor Academic Performance in science at the secondary school level (Ifeakor, 2006; Udo, 2006; Okafor, 2000). It is on this note this research wish to examine the

impact of Laboratory Facilities on academic performance and interest of students in wave concept of secondary school physics in Zaria education zone.

School Laboratory Facilities have been observed by Yara, and Otieno (2010) as a potent factor to quantitative education. The importance to teaching and learning of the provision of adequate instructional facilities for education cannot be over-emphazied. The dictum that "teaching is inseparable from learning but learning is not separable from teaching" is that teachers do the teaching to make the students learn, but students can learn without the teachers. According to Oni (1992), facilities constitute a strategic factor in organizational functioning. This is so because they determine to a very large extent the smooth functioning of any social organization or system including education. He further stated that their availability, adequacy and relevance influence efficiency and high productivity. In his words, Farombi (1998) opined that the wealth of a nation or society could determine the quality of education in that land; emphasizing that a society that is wealthy will establish good schools with quality teachers, learning infrastructures that with such, students may learn with ease thus bringing about good academic performance.

Laboratory has been conceptualized as a room or a building specially built for teaching by demonstration of theoretical phenomenon into practical terms. Farombi (1998) argued the saying that "seeing is believing" as the effect of using laboratories in teaching and learning of science and other science related disciplines as students tend to understand and recall what they see than what they hear or were told. Laboratory is essential to the teaching of sciences and the success of any science course is much dependent on the laboratory provision made for it. It could be described as a place where theoretical work is practicalized whereas practicals in any learning experience involves students in activities such as observing, counting, measuring, experimenting, recording, observation and carrying out field work.

These activities are totally different from the theoretical work which involves listening to talks and taking down notes from such talks. Laboratory work Stimulates learners' interests as they are made to personally engage in useful scientific activities and experimentation; Promotes that science is not only products or process; affords the learner the basic skills and scientific method of problem solving; Knowledge obtained through laboratory work promotes long term memory.

Laboratory helps to provide a forum wherein the learner is given the exercise to subjects, his beliefs, ideas, statements, theoretical propositions etc. to some forms of experimental test (Soyibo, & Nyong 1984). To maintain and arouse the interests of students in subjects involving laboratory work, the teacher should be effectively involved in order to transfer knowledge and facts to learners for a good performance in any examinations. In line with this, one then pauses to ask, to what extent has laboratory been able to achieve its objectives.

However, there are growing evidences that teachers do not exhibit behaviours which are complementary to achieving the stated objectives. They include methods of teaching practical work; inadequacy or absence of well-equipped laboratories; high enrollment of students; inadequacy of resources for teaching and learning practical work; quantity and quality of teachers.

Writing on the situation of our secondary schools today, Okoli (1995) reported that laboratories have become shelves of empty bottles of chemicals. In terms of academic performance, Soyibo and Nyong (1984) have shown that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are ill-equipped. In the words of Ogunleye (1999), one of the recurrent problems of teaching of science is that of large classes. He remarks that one of the objectives of teaching science in schools is to communicate the sprint of science in

schools and to ensure that students acquire the process skills of science. This cannot be effectively achieved unless students are exposed sufficiently to practical work and laboratory experimentation. Unfortunately, Ogunleye continued, that many secondary schools established over the years still remain without science laboratories while others have laboratories that are not sufficiently equipped. It is accepted that the major function of education is to prepare learners for livelihood, to equip him with basic skills and knowledge, to enable him with basic skills and knowledge, to enable him live as a useful productive individual and a good citizen.

Okoli, (1995) opined that no course in science and mathematics can be considered as complete without including some practical work. The practical work ought to be carried out by individuals either in science laboratories or in classes. At school level, practical work is even more important because of the fact that we learn by doing. Scientific practices and applications are thus rendered more meaningful. It is an established truth that an object handled impresses itself more firmly on the mind than the object merely seen from a distance or in an illustration. Thus practical work forms an important feature in any science and mathematics course (UNESCO, 2008). In view of these different findings, the study found the relationship between teachers' quality and students' academic performance.

Owoeye and Yara (2011) investigated the provision of Laboratory Facilities as it relates to Academic Performance of students in agricultural science in Ekiti state of Nigeria between 1990 and 1997, the results shows that there were no significant differences in the performance of students between rural and urban secondary schools in term of availability of laboratory facilities. Adeyemo (2012) conducted study on the influence of teachers' supply and the provision of Laboratory Facilities on students' performance in physics. The finding from the study indicated that adequate provision of

Laboratory Facilities plays a significant role in boosting students' performance in physics. In chemistry, John and Nja, (2014) accertained that in recent times, the provision of Laboratory Facilities in secondary schools in Calabar have yielded little or no result in terms of students' Academic Performance . In this study, Laboratory Facilities were used as a variable and its impact on academic performance were investigated.

In using laboratory method there is a need of observance of safety by the teacher and students. Laboratory safety implies all the precautions in the laboratory that aim in ensuring users' safety and prevent the occurance of accident or injury. Ajayi (1996) reiterated that when facilities are provided to meet relative needs of a school system, students will not only have access to the reference materials mentioned by the teacher, but individual students will also learn at their own paces and thus, it requires some precautions for their utilization. Scholars, (Okoli 1995; Owoeye and Yara 2011; Adeyemo, 2012) and professional bodies (STAN, 2002) advocated the following safety rules in the laboratory:

- Students are not allowed into the lab without permission
- No play or jokes is permitted in the lab
- Students should read the background materials on the experiment, the purpose of lab work and the experience they are to get from it
- Students must be asked to reach each part of the lab work- experiment very carefully so as to know that they are going to do and what apparatus they will need
- Students must not drink or eat in the lab
- Students must dispose waste paper and dirty material in waste baskets in the lab

- Electrical equipment should never be handled with wet hands; such may cause shock or electrical accidents
- Students are not allow to charge phones, in the lab or sticking any object into electrical sockets or outlets
- The fire fighting equipments such as fire bucket, carbon-dioxide extinguisher and sand bucket should be available in the lab and to the knowledge of both the staff and students
- Never set up any equipment to run over night in the lab. Students are not allowed to touch the chemicals or solutions unless they are told to do so.

The overall essence of laboratory safety is ensuring free and peaceful atmosphere through prevention of accident and injuries in the conduct of the practical (Owoeye & Yara 2011). This study, therefore, used Laboratory Facilities as an instructional strategy and examined their impacts on academic achievement and interest among students.

2.6 Curriculum Implication of Computer-Aided Instruction.

Curriculum is concerned with what is learned, taught and how this learning and teaching occurs. What is taught or learned includes objectives, contents and learning outcomes.The existence of Computer-Aided Instruction into this world has brought a lot of changes in every human endeavor especially in educational sector and even at Senior Secondary School Level.In effect, these changes demand the need to adjust Senior Secondary School Level programme towards Computer-Aided Instruction innovations so that both students and teachers will take initiative in redesigning curriculum and making changes to meet the emergency need of Computer-Aided Instruction.This is what wubbles, Adeyegbe (1993) asserted that curriculum also has a place in the relationship dimension of the environment in that the students and teachers are focused on certain process and content in the curriculum and have a relationship with the curriculum and

the methodologies that are associated with conveying the curriculum students and teachers may have very different relationship with different component of the curriculum.

Aburime (2004), observed that the use of Computer-Aided Instruction impacts on both declarative and procedural knowledge to such an extent that clearly the current curriculum and learning were not designed to accommodate the increasingly rapidly expanding quality of curriculum to be positive. However, with the use of Computer-Aided Instruction, students can be encouraged to address real problems and develop analytical and interpretive skills. The classroom can be transformed into learning community making it possible for many more people to be a part of the learning process in an open dialogue.The effective teaching of Senior Secondary Level requires facilities for its wave application and support from schools authority for students so that they can apply what they have learned; this has many aspects of which include:

- The need for provision of a laboratory or recognized place for performing practical so that the practical is given due consideration.
- Facilities needed to be provided such as Computer-Aided Instruction facilities to enable students send and receive information treated in the text books or classroom.
- Due to the new approach in the Senior Secondary Level curriculum the Federal Ministry of Education need to organize retraining course on IT for teachers in Senior Secondary Level.

2.6.1 Challenges of Senior Secondary Physics Curriculum Implementation.

Curriculum implementation is a network of varying activities that involved in translating curriculum designs into classroom activities and changing peoples' attitudes to accept and participate in these activities (Okello & Kegoire, 1996). Teachers are the curriculum implementers and in the process are faced with some barriers which hinder the successful implementation of the curriculum. Such barriers are what a scholar (Mangal, 2010) termed as impediments to curriculum implementation, and include among others, under funding, unavailability of school facilities and equipments, deplorable condition of infrastructure,insufficient supply of trained teachers, and poor time management by school administrators and teachers (Sibulwa, 1996 & Mangal, 2010).

Sibulwa (1996), observed that underfunding raised a big challange to curriculum implementation which is determined by the economy of a nation. In developing countries, for example, the number of students and teachers has kept on rising and government fund available for education is limited. The scholar reported that, the bulk of money allocated to education is absorbed by salaries leaving very little for teaching materials, books, staff development programme such as in-service training, monitoring and evaluation of teaching learning process. The fact that educational sector is underfunded by the government means that the availability and quality or facilities in learning institutions is affected negatively.With the absent of effective evaluation, it will be difficult to know whether the curriculum is being effectively implemented or not.

Deplorable condition of buildings in educational institution is another hinderance to effective curriculum implementation. In Zambia, for instance, Kelly (1999) describes the buildings as dilapidated, unsafe and sometimes unusable for teaching and learning process. Quality of teaching staff to meet the expectations of students is another

impediment. Teachers are the most important human resource in curriculum implementation and successful implementation of curriculum depends on them (Okello & Kagoire ,1996; Mangal, 2010). The scholars added that sufficient supply of trained teachers is therefore, needed if the implementation of the curriculum is to be effective.

Similarly, in the absence of apparatus and chemicals needed for experiments, a science teacher will teach experiments theoretically, denying the learners the practical aspect of the content. And also teachers who are ill – equipped with Computer-Aided Instruction facilities to teach some concepts such as electricity may have no alternative than to use Lecture Method undemining active particupation of students (Kingsley, 2011; &Josiah, 2012). Poor conditions of services for curriculum implementers are another challenge. It demoralizes teachers who may resort to go into private commercial enterprises to supplement meager salaries. If various education policies and programs are to be effectively implemented, teachers ought to be adequately trained and motivated. After pre – service training which provides foundation for professional service, teachers need to keep abreast with new developments in the system through in-service training, workshop and seminar, in order to give sound support to the teaching staff and students in the implementation of the curriculum.

Classroom time management is another crucial factor in the implementation of curriculum and the class teacher is the main player. In most schools, a lot of time is taken up by activities such as assemblies, meeting, visiting government officials, health talks, in house workshop, unplanned holidays (such as when a teacher dies, teachers' day, democracy day) and many other unforeseen eventualities that take place at the expense of learners. A teacher who is not time conscious is not disciplined and draws back in as far as curriculum implementation is concerned. Teacher absenteeism from work for various reasons also costs the pupils learning time. Kelly (1999) stressed that, the need to devote

inordinate amount of time to the management of problems of large classes effectively reduce students' time on the learning task which results in the failure to complete the intended content for the lesson and will necessitate the allocation of more time to the same task. Apart from that, mock and final examinations also take up learning time for non – examination classes.

This study, therefore, used Computer-Aided Instruction as instructional strategy and examined its impact on intrest and academic performance of students in wave concepts of physics.

2.7 Lecture Method

The term Lecture Method is a teaching method regarded as traditional method of teaching in our educational institutions. Lecture Method involves verbal presentation of ideas, concept and generalization of facts (Umar, 2006, Atadoga, 2008). It is a method in which the teacher delivers pre planned lessons to the students with little or no instructional aids. In using this method, the teacher talks about science while the learners read about science (Maikano, 2007). It is a science teaching instructional method that encourages rote learning and regurgitation of information (Bichi,2002; Atadoga, & Onaolapo, 2008).

Lecturing, as a method, is used largely to build up basic theoretical knowledge which must be acquired by the students before he is able to display practical skills and undertake practical tasks in the laboratory. It is highly valued in a situation where the number of students, who are benefiting from it, is quite large and in a situation where there is inadequate number of competent and qualified teachers coupled with the insufficient instructional materials. Lecture Method with note taking technique may be more effective than any other type of method.

The method is used to introduce students to a new subject, summarize ideas, showing relationships between theory and practice, and highlighting the main points. In Lecture Method, theory is taught as an absolute knowledge. Hence, pupil-centered activities for developing scientific reasoning skills and process are lacking. Kumar (2003) pointed out variety of Lecture Methods used in our schools, viz: The expository lecture:Illustrated lecture: The Lecture – Recitation: Lecture-Demonstration: The interactive lecture: However, the overwhelming majority of the researchers (Abdullahi, 2009; Atadoga & Lakpini, 2010; Josiah, 2012) agreed that Lecture Method is not effective in teaching science as it deviates from hands-on-minds. This study adopts Lecture-Demonstration as strategy for teaching control groups.

On the issue of relevance of Lecture Method, scholars (Kumar, 2003; Abdullahi, 2009; Atadoga, & Lakpini, 2013).posited that Lecture Method allows the coverage of large content, large population of students as well as economical in terms of time. However, it does not necessarily hold the students' attention or permit active participation, hence teacher-centred approach. To make Lecture Method effective, researchers(Amosun, 2008; Abdullahi, 2009; Usman, 2010; Obeka, 2010, Abdulkarim & Lawal, 2012) recommend integrating it with and other references such as the use of Computer-Aided Instruction and laboratory facilities.

Studies conducted on Lecture Methods and other strategies revealed significant difference. Usman (2010) compared indoor and outdoor laboratory method on academic performance of integrated science students at junior secondary school level. The researcher used Lecture Method as control. The finding revealed that the two methods are superior over Lecture Method in improving students'academic performance.In a related study, Obeka (2010), studied the effect of inquiry and demonstration method on academic performance, interest and retention in environmental education concepts of

geography. Here, Lecture Method was used as treatment for control group. Analysis of the result involved the use of ANCOVA and the result indicated that students in the control group perform less than expectation than their experimental groups

In studying Physics, students acquire the knowledge and the skills to understand how and why natural things happen the way they do; to make predictions and venture into unknown areas of knowledge and more importantly using the knowledge and skills to design and make new things. Physics is the study of events in the universe (both remote and immediate universe). A physicist looks at the matter making up the universe, the motion and energy of matter, the cause effect relationship of matter and energy, and the application of natural phenomena.

Abdullahi (2009) maintained that lecturing when appropriately used as a teaching method were useful in imparting factual information in an efficient manner to convey facts, concepts and principles to students who have difficulty in reading their texts, motivate, inspire and instigate a student towards creative thinking and helps to get thinking patterns of students become more focused. Lecture Method is linked with short comings of running quite contrary to the major aims of science education. There is no provision for activities in the method as students are reduced to the status of passive listeners. Students do not find scope to get involved in independent and useful thinking and therefore do not get trained in the scientific method of problem-solving. Lecture Method is psychologically unsound because it lays emphasis on subject-matter content and does not take into cognisence on the needs and requirements of the learners and does not cater for the individual needs and individual differences amongst students (Amosun, 2008).

Olorukooba, Lawal and Jiya (2012) revealed that Lecture Method is ineffective in enhancing Academic Performance of NCE Biology students in evolution concept when

compared with analogy teaching strategy. In this study, Lecture Method was used as a teaching method for control group.

2.8 Interest and Academic Performance in Science Education.

Scholars (Sambo, 2008; Mangal, 2010) have emphasized the need of teachers to incoporate the three domains of students (affective, psychomotor and cognitive) in teaching learning process. While cognitive dealts with academic performances of students, affective domains is concerned with beliefs, attitudes, interest, motives, feelings, emotionsneeds and satisfaction of a student (Lagoke, 1997). However, for students to develop desired attitudes toward any concept, there is need to get them interested in it through effective teaching.

Interest is a feeling of curiosity or concerned about subject that makes the attention turn towards it. Okafor (2000), described interest as the attraction which forces or compels a child to respond to a particular simulus. Obeka (2008), views interest as the course of certain actions which acts as drive that propel students' to act in certain ways. It is a type of attitude when share in some characteristics of cognitive, affective and psychomotor components.

Aggarwal (2008), is of the opinion that interest is a feeling that prompts individual to impulsive acts. It is an inspiring vigor that impels students to attend to an activity as well as effective experience that has been stimulated by the activity itself. Mangal (2010) defines interest as a great motivating force and reservoir of one's inner potential, capable of molding and shaping one's behavior and personality in a particular field.Obeka (2008) noted that inspite of zeal, determination and sincere interest, students' interest and ability can be dampened by the use of ineffective teaching method such as the traditional lecture. There has been continuous effort by scholars toward purposeful academic performance. However, there has not been any generally agreed pattern of influence of

sex on academic performance and interest (Obeka, 2008). While some students shows no difference others shows some difference due to gender.

Nworgu (1990) found significant gender difference on students' performance in favour of the female while there was no significant influence on interest.Obeka (2008), revealed no significant difference in the interest ability of male and females students in environmental education concepts of geography due to exposure to demonstration and inquiry teaching methods. Added to this, Mari (2010), study on entry qualification and performance revealed that male and female students admitted with the same entry qualification have no difference in their performance.

Therefore, different views of researchers on the influence of gender on interest necessited for further research in physics. Hence, this study used Computer-Aided Instruction and Laboratory Facilities as an instructional strategy and examined their impacts on students'interest on wave concept.

2.9. Gender and Academic Performance in Science Education

To achieve is to accomplish or gain by effort or do something successfully with an effort and skill. The performance referred to in this study is the academic performance of students in physiscs. Academic performance as one of the variable of this study is the level of performance in the subject as exhibited by an individual.Busari (2006), defined academic performance as the display of knowledge attained by students in the school subject. Poopola (2010), stated that, academic performance is an expression used to present students' scholastic standing and which is a function of a various factors such as method of teaching, teachers' qualifications, child's home background, school environment, attitude, and interest, among others.

According to Okafor (2000), academic performance is based on the degree of intellectual simulation that the child could receive from learning situations. Obeka

(2010) observed that the teacher plays a very crucial role in the development of performance motive of the learners by providing a conducive environment for learning in and outside the class. The researcher added that,in a classroom environment where the standard are too low, boredom, poor morale, idleness and noisy behavior leading to poor academic performance can set in.

Physics, according to Adeyemo (2010), is a unique subject, which promotes the acquisitions of specialized science skills and knowledge, which explains the natural phenomena of life in the society and has contributed to the development of the sciences and to the development of civilization. Despite all these benefits, reports (Adeyemo, 2010; WAEC, 2013; NECO, 2012), indicated that students' performance in the subject is relatively poor over the years. This has become a source of concern to parents, teachers, government, and other stakeholders in education. According to previous studies, WAEC, (2013), factors attributed to this poor academic performance includes, among others, insufficient man power, equipment, poor attitude of students, poor understanding of the concepts due to their abstract and difficult in nature, utilization of inappropriate and uninspiring teaching methods in schools, poor quality school science teachers and school location. The problem confronting Physics students in Nigeria is that some of the teachers are poorly qualified as such unfamiliar with the names and use of some science equipment and facilities (Ekpo & Ifereke & Chikwelu, 2007).

As the educational sector is faced with series of changes and reforms in Nigeria and other developing countries, and as Nigerian government places higher emphasis in achieving millennium development goals (MDGs) by 2020 through science and technology, it is good to reflect on matters concerned with physics and the dissemination of physics knowledge and lessons. Numerous teaching strategies have been developed by scholars (Eshiet, 1996; Abdullahi, 2009; Okam, 2009; Atadoga & Lakpini, 2013), which

correspond to the accommodation of students' need and diverse learning method and consequently, students academic performance.

Alpha (2006), in his research on Gender Disparity on Performance in Mathematics of Senior Secondary School, revealed significant difference in the academic performance of boys and girls in mathematical concepts in favour of boys. In addition, Usman (2010), supported this view in his work "relationship between students' performance and their academic performance in Biology using NISTEP mode of teaching. The researcher found that senior secondary male biology students perform well in any rigorous work than their female counterparts. In geography, Obeka (2008), revealed that male students performed better than females in environmental education concepts of geography due to exposure to teaching.Contrarily, Mari, (2010) study on entry qualification and performance revealed that male and female students admitted with the same entry qualification have no difference in their performance.

This study, therefore, used Computer-Aided Instruction and Laboratory Facilities as an instructional strategy and examined their impacts on students' academic performance in wave concepts.

2.9.1. Overview of Similar Studies

Various studies related to Computer-Aided Instruction, laboratory facilities and lecture methd were conducted previously addressing several issues. For example, Josiah (2012) investigated the effects of Computer-Aided Instruction (CAI) on the performance in Physics of Nigerian rural and urban secondary school students involving a sample of Forty (40) SS III students in Pankshin Local Government Area of Plateau State, Nigeria were tested on the concepts of space, time and motion using a developed 25-item Physics Performance Test (PAT). The formulated hypotheses were tested using the pooled variance formula of the student t-test statistic. The result revealed that there was no

significant difference in the mean Physics performance scores between urban and rural students taught Physics with CAI. Furthermore, there was no significant difference in the mean Physics performance scores of male (68.90) and female (67.60) students treated with CAI.

Arinze, Okonkwo, and Iwunor (2012), investigated the availability of ICT in public and private junior secondary schools. The scholars investigated other variables such as skills competence of social studies students, and the influence of ICT on the Academic Performance of students. It was a descriptive survey research covering a sample size of eight teachers and twenty four students from Onitsha South L.G.A in Anambra selected using simple random sampling technique. The finding of the study shows that the ICT availability in secondary schools is very low and students have low competence on the application of ICT in learning and proved effective in raising the interest and performance of students. The study have relation with the present study since it use variables such as availability of Computer-Aided Instruction, academic performance and interest of students.

Grace and Nkiru (2013), investigated the relationship between instructional Television (ITV) programmes and Academic Performance of Senior Secondary School students in Anambra state-Nigeria. The study adopted survey research design using questionnaire, interview schedule, and academic curriculum as instruments for data collection. The questionnaire was administered to 500 students drawn from a population of 50,832 senior secondary school students in Anambra state. The analysis of the result involved the use of t-test. Result revealed that there was a slight difference in the Academic Performance of those who watched and those who did not watch ITV programmes.

Owoeye and Yara (2011) investigated the provision of Laboratory Facilities as it relates to Academic Performance of students in agricultural science in Ekiti state of Nigeria between 1990 and 1997. The study was an ex-post factor design using results of the West African School Certificate Examinations (WASCE) conducted between 1990 and 1997 in 50 secondary schools in both rural and urban areas of the state. One hypothesis formulated was analysed using t – test. The results shows that there were no significant differences in the performance of students between rural and urban secondary schools in term of availability of Laboratory Facilities.

Adeyemo (2012) conducted study on the influence of teachers' supply and the provision of Laboratory Facilities on students' performance in physics. A total of two hundred and seventy (270) randomly selected SS (11) physics students and ten (10) physics teachers in Lagos state served as the subjects for this study. The study adopted a simple survey design. The Research Questions were investigated and three hypotheses were duly tested using analysis of variance (ANOVA). The finding from the study indicated that adequate provision of Laboratory Facilities plays a significant role in boosting students performance in physics, The main and interaction effect of the provision of Laboratory Facilities influence students' performance in physics. In this study, the researcher investigated the impact of Laboratory Facilities on interest and students'academic performance in wave concept of physics.

John and Nja, (2014) evaluated the extent of adequacy of Laboratory Facilities on students' Academic Performance in Calabar. A total number of three hundred and fifty copies of questionnaire were administered to Chemistry students in order to assess the facilities impact on the students' Academic Performance . The results obtained from the data collected and analyzed shows that Laboratory Facilities in secondary schools are not adequately enough for teaching chemistry. The result also showed that adequacy of

facilities does not significantly contribute to the variance in students' Academic Performance s in chemistry.

2.9.2 Implications of the Review to the Present Study

From the review so far, scholars and authorities in science education such as Arinze, Okonkwo, and Iwunor (2012), Adeyemo (2012), John and Nja, (2014) were able to identify that teaching methods and resources for science teaching plays a significant role in the level of achievement of students. Several issues such as availability of Computer-Aided Instruction and laboratory facilities were discussed and left unresolved. While some scholars such as Arinze, Okonkwo, and Iwunor (2012) were able to identify the extent to which computer assisted facilities are available, other researchers claimed unavailability of Computer-Aided Instruction and laboratory facilities in our secondary schools. This review has an implication to the present study as it pointed out the need to further established the argument to whether the facilities are adequate or inadequate with reference to the provision of National Policy on Education (FRN, 2013)- a missing gap filled by the present study.

The literatures reviewed have pointed out some of the researches conducted related to this study. Most of the researches were on students' performance, location and attitude. However, the review shows that studies neglected investigation on areas such as availability of Computer-Aided Instruction in teaching physics, availability of laboratory facilities in teaching and learning physics as well as their impact on academic performance among gender at senior secondary level a gap to fill by this study. Consequently, this study was conducted to fill the missing gaps in determining whether Computer-Aided Instruction and laboratory facilities are available for teaching Physics in senior secondary schools of Zaria education zone. At the same time the study intends to fill the gap on examining whether the use of Computer-Aided Instruction and

laboratory facilities in teaching physics have any impacts on academic performance of physics students.

Similarly, previous studies were geared on cognitive aspect of teaching strategies among students neglecting psychomotor and affective component of students. Hence, this study used interest as a variable of students' learning beside the cognitive aspect. At the same time, many students conducted revealed gender inbalance among students due to teaching methods. This study intended to fill the gap of gender inbalance among students using Computer-Aided Instruction and laboratory facilities in teaching.

The review has helped tremendeously on identifying methodologies adopted by scholars in conducting their researches and limitations associated with such methodologies. For example, research designs adopted and data analysis procedures of most researches are incapacitated in producing empirical evidences to support research data. This is because many researchers use survey designs and tested their hypotheses using percentage score methods which are considered as weak. This guided the researcher in choosing appropriate research design with highly statistical techniques to support research findings.

Therefore, the review has some implications to this study as the researcher were able to identify the following gaps filled by the present study:

1. Unresolved debate to wether Computer Aided instruction and laboratory Facilities are available in teaching physics fave way to the first research objective in this study,
2. Persistent mass failure in SSCE physics is associated with the use of lecture method, non of the previours studies attempted to enriched lecture method with instructional facilities or the use of Computer Aided Instruction, another missing gap filled by this study.

3. Most of the previours studies take into account the cognitive domain of students and neglecting affective (interest and attitude). This study focus on both cognitive and affective domains of students.
4. Similarly, gender issue were neglected by most of the previours studies and the present study have taken care of gender in physics.
5. Most of the researches on Computer Aided Instruction were conducted in some countries. Eventhough few literature exist in southern part of Nigeria, none of such studies were conducted in Zaria Education zone as far as the researcher is concerned.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This study examined the impact of Computer-Aided Instruction and Laboratory Facilities on interest and academic performance in wave concept of physics students at Senior Secondary School level in Zaria education zone, Kaduna State.This Chapter therefore, presents the methodology of this study under the following sub-headings:

- Research Design
- Population of the Study
- Sample and Sampling Technique
- Instrumentation
- Validity of the Instruments
- Pilot Testing
- Reliability of the Instruments
- Administration of Treatment
- Data Collection Procedure
- Procedure for data Analysis

3.2. Research Design

Two research designs: namely, Survey and Quasi-experimental designs involving pre-and post-tests were used in this study. In survey, the researcher is interested in determining the availability of Computer-Aided Instruction and Laboratory Facilities in secondary schools of the study area. In quasi experimental design, the researcher seeks to determine the impact of Computer-Aided Instruction and Laboratory Facilities on academic performance and interest of physics students in wave concept. In quasi

experimental design, both the experimental and control groups were pre-tested (0_1) before treatment. The treatment (X_1) is teaching using Computer-Aided Instruction (for Experimental group 1, EG1) and Laboratory Facilities (for Experimental group 2, EG II). Control group (Xo). This is followed by Post test (O_2) to determine students' academic performance in the content taught. The research design is represented in figure 3.1

EG1 → O_1 → X_1 → O_2

EG2 → O_1 → X_1 → O_2

CG → O_1 → X_0 → O_2

Fig 3.1: Research Designed Illustration

Where:

EG1= Experimental group 1 (Computer-Aided Instruction)

EG2= Experimental group II (laboratory facilities)

CG= Control group

X_1 = Treatment (Teaching using Computer-Aided Instruction and laboratory facilities)

X_0 = Lecture Method.

O_1 = Pre-test

O_2 = Post-test

3.3. Population of the Study

The population of this study covered all SS II physics students in public Senior Secondary Schools offering physics in Zaria education zone. In this zone, available data from Kaduna State Ministry of Education, (KDMOE, 2015) revealed that there are twenty Public Senior Secondary Schools with population of one thousand six hundred and ninety six (1,696) SS II physics students as at 2014/15 academic session. The attribute of the population is that majority of the students in the study area are Hausa by tribe, followed by Yoruba, Igbo and with about12% constituting minorities. The population cut across gender and students of SS II with average age of 17 years. In this study, there are ten coeducational schools, four boys' schools and six girls' schools. Table 3.1 gives the detail population of the study:

Table 3.1: Population of the Study

S/N	School	No. of SSII Students		Total
		M	F	
1	GSS Zaria	100	-	100
2	GSS Tudun Jukun	100	60	160
3	GSS Magajiya	30	38	68
4	Barewa College Zaria	130	-	130
5	GGSS D/Bauchi	-	173	173
6	GGSS Zaria	-	48	48
7	GSS Aminu	33	37	70
8	S.I.A.S.S Karau-Karau	40	20	60
9	GGSS K/Gayan	-	100	100
10	GGSS Pada	-	80	80
11	GSS Kaura	170	-	170
12	GSS Chindit Barracks	92	-	92
13	GSS Dakace	30	26	56
14	GSS T/Saibu	30	19	49
15	GSS Kugu	06	04	10
16	GGSSChindit Barracks	-	60	60
17	GSS Muchia	38	22	60
18	GSS Likoro	20	15	35
19	AlhudahudaCollege Zaria	-	120	120
20	GSS K/Kuyanbana	35	20	55
Total		854	842	1,696

Source: (Kaduna State Ministry of Education, 2015).

3.4. Sample and Sampling Technique

A total number of 198 SS II Physics students from three public Senior Secondary Schools of Zaria education zone formed the sample of this study. Systematic sampling technique was employed in selecting the study sample. The technique begins with balloting in which all the schools were written on sheets of paper, folded and placed in a container. A small boy aged 3 years was asked to picked six papers from the six schools selected. A pre-test was administered by the researcher to ensure selection of samples

that are not significantly different in terms of academic performance. The result of the test was subjected to Analysis of Varience (ANOVA) for selecting three schools that formed the sample of this study. To ensure unbias selection, the result of the ANOVA was further subjected to scheffer's test for final selection of schools with equal performance statistically. The choice of 198 students as a sample is supported by Sambo (2008), and central limit theorem that proposed a minimum of thirty subjects in experimental research.

In assigning schools into groups, balloting technique was employed. First, the three schools were individually folded in a paper. A small boy was asked to placed each paper in the three cans lebeled experimental group 1 and 2 and control group. It is to be noted that intact classes were used for the study. Detail of the sample of this study is presented in Table 3.2 .

Table 3.2: Sample for the Study

School	Status	Male	Female	Total
GSS Magajiya	Experimental I	30	38	68
GSS Muchia	Experimental II	38	22	60
GSS Aminu	Control	33	37	70
Total		101	97	198

3.5. Instrumentation

Three research instruments were developed by the researcher for this study. The instruments are targed; Availability of Computer-Aided Instruction and Laboratory Facilities Questionnaire (ACAILFQ), Wave Performance Test (WPT) and Wave Interest Inventory Questionnaire (WIIQ) respectively.

3.5.1 Availability of Computer-Aided Instruction and Laboratory Facilities Questionnaire (ACAILFQ)

This is a-42 item Checklist developed by the researcher to determine the Availability of Computer-Aided Instruction and Laboratory Facilities in teaching wave concept of physics. The instrument was structured to determine the availability of the facilities. If available, in what quantity? Observation technique were used in this regard.

3.5.2. Wave Performance Test (WPT).

This is a-40 item performance test developed by the researcher using content on SSII wave concept of physics. This instrument is used to determine the students' performance in physics. The instrument was developed with the aid of blooms taxonamy of educational objectives. This can be seen in Table 3.3

Table 3.3- Table of Specifications

Content	Wg (%)	K (27.5)	C (20)	A (20)	An (10)	S (10)	E (12.5)	T (100)
1.Concepts of waves	(15)	2	2	1	0	0	1	6
2. Types of waves.	(25)	3	2	2	1	1	1	10
3. Properties of waves	(25)	2	2	3	1	1	1	10
4. Light and sound waves	(20)	3	1	1	1	1	1	8
5. calculations involving waves	(15)	1	1	1	1	1	1	6
Total	(100)	11	8	8	4	4	5	40

Source: (Adapted from Sambo, 2008 & Obeka, 2011)

3.5.3. Wave Interest Inventory Questionnaire (WIIQ).

This is a-20 item interest inventory questionnaire developed to determine the interest of students on wave concept of physics developed using the Likert's 5- point rating scale. These are; Strongly agreed (S.A); Agreed (A); Undecided (U); Disagreed (D); and; Strongly disagreed (S.D). Weight is assigned to each option from five to one.

3.5.4. Validity of Research Instruments

The three instruments were presented to five Ph.D holders with a rank of Senior lecturer and above in the department of Science Education and educational psychology, gguidance and counselling, Ahmadu Bello University, Zaria, for content and face science validations. The experts were required to:

- check the content and its suitability on the subjects,
- determine whether the content is appropriate in testing the study subjects in terms of difficulty level,
- check the appropriateness of the instrument and
- check time allocated for the Wave Concept Performance Test(WCPT)

From the validation report, the following amendments were made:

1. number of items in the Achievement test were reduce from 50 to 40.
2. Grammartical editing were made.
3. Items that can not measure performance in wave concepts were considered irrelevant and removed.

3.5.5. Pilot Testing

The three instruments were subjected to pilot testing to a group of 20 students in one secondary school (Barewa College Zaria) within the population but outside the sample and administered once to the group of testees after which split half method was used and analysed using Spearman Brown formula. The Wave Concept Performance Test (WPT) was administered twice to the same group of students using test re-test method with interval of two weeks based on Tuckman(1975) recommendation

3.5.6. Reliability of the Instruments

Reliability is the consistency of the test to produce similar result after several times of administration. Test re test method was adopted and Pearson Product Moment

Correlation coefficient statistics was used in determining reliability coefficient of the instrument.The result of the analysis revealed that the reliability coefficient of Availability of Computer-Aided Instruction and Laboratory Facilities Questionnaire (ACAILFQ) was found to be 0.8, Wave Performance Test (WPT) is 0.7 and Wave Interest Inventory Questionnaire (WIIQ) is 0.9 respectively. The result comfirmed that the instruments are reliable.

3.6. Administration of Treatments.

After validation of the two instruments and lesson plans, the researcher administered the instrument without involvement of research assistance. Availability of Computer-Aided Instruction and Laboratory Facilities in teaching wave concept of physics (ACAILFQ) was administered first followed by Wave Performance Test (WPT) and Interest Inventory Questionnaire (WIIQ) before administering the treatments. The treatments involved observation of the Computer-Aided Instruction and Laboratory Facilities in possesssion of the department and teaching using the three methods as follows:

Experimental Group I (Computer-Aided Instruction, CAI)

The class was exposed to CAI using laptop connected to LCD projector and desktops. At the beginning, the teacher introduced the lesson before the computer presentation on wave concept. Also, students were assigned into groups. From each group some members were assigned with different responsibilities such as group leader, time-keeper, and scribe/quiet captain. These responsibilities were rotated weekly among the team members. As part of the introductory session, concepts are presented to students in form of visualization to link their previous knowledge with the new topic to be taught. For instance, to introduce the definition of wave, the teacher shows a film of stationary water disturbed by stick, or snake in motion to the class. The class observed the

presentation and comment on it. The groups were exposed to CAI and members were provided with computers, and tasked to complete the reading of the materials; perform the tasks (assignment) marked and recorded against group scores. After each lesson, each task received a grade and each group members received the group grade.

Students were encouraged to listen, observe, perform tasks and write down note. In addition, after the computer presentation, the teacher opens a discussion on the lesson. Comments, questions and discussions were entertained and more worked examples were provided. A flowchart of the strategy was presented in Figure 3.2:

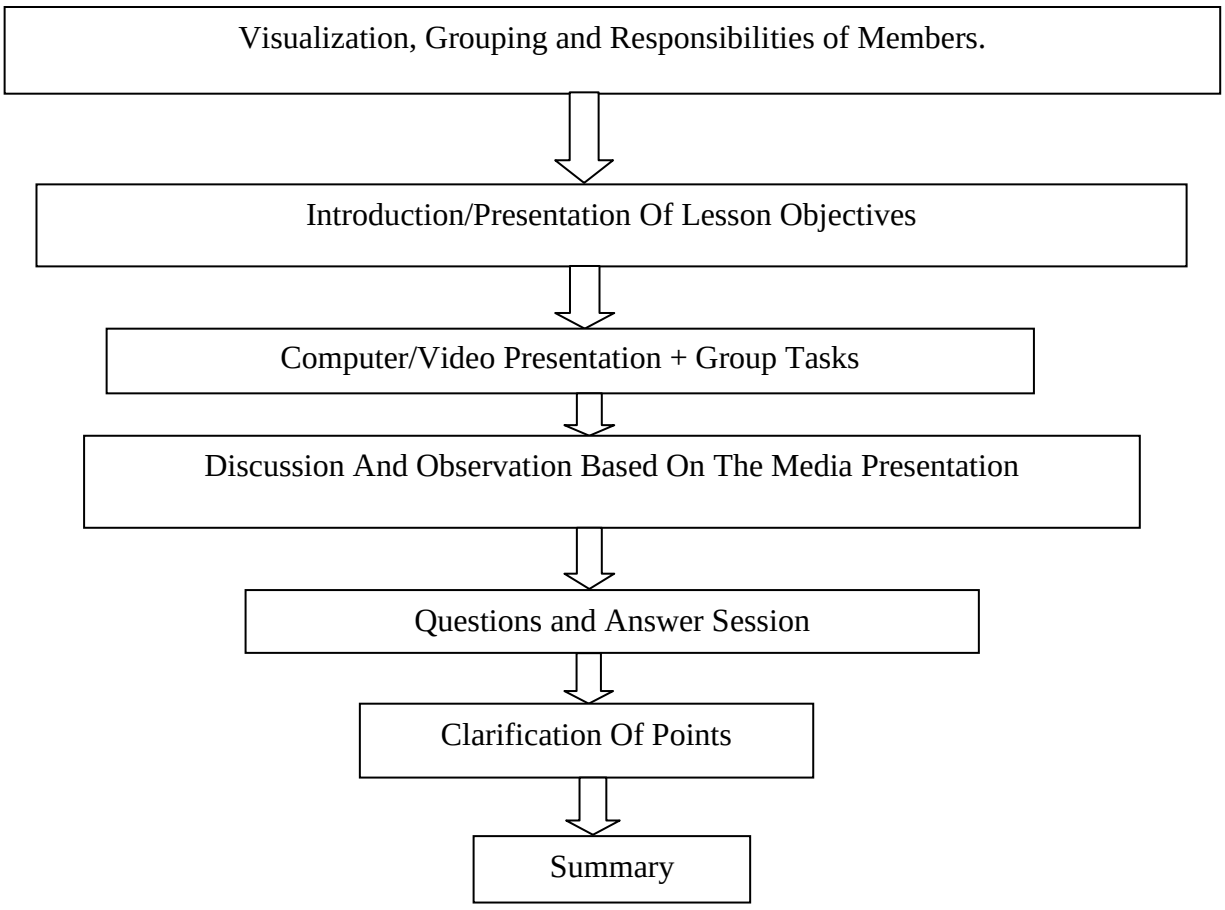

Fig. 3.2: Flow chart of Computer-Aided Instruction teaching strategy
Source: (Adapted from Ogu, 2003).

Experimental Group II: Laboratory Facilities: The group was exposed to teaching using Laboratory Facilities. At the beginning, the teacher grouped and assigned

responsibilities to members. From each group some members were assigned with different responsibilities such as group leader, time-keeper, and scribe/quiet captain. These responsibilities were rotated weekly among the team members. The groups were made known of the objectives of the lesson, provided with Laboratory Facilities for teaching wave concept and text books. The teacher carries students along, demonstrate practical aspects of waves, ask them to complete the reading of the materials; perform the tasks (assignment) marked and recorded against group scores. After each lesson, each task received a grade and each group members received the group grade. Students will discussed and made observations based on each lesson. Students were encouraged to listen, observe, perform tasks and write down note. In addition, after the lesson, the teacher opens a discussion on the lesson. Comments, questions and discussions were entertained and more worked examples were provided. Detail of the strategy is illustrated in Figure 3.3.

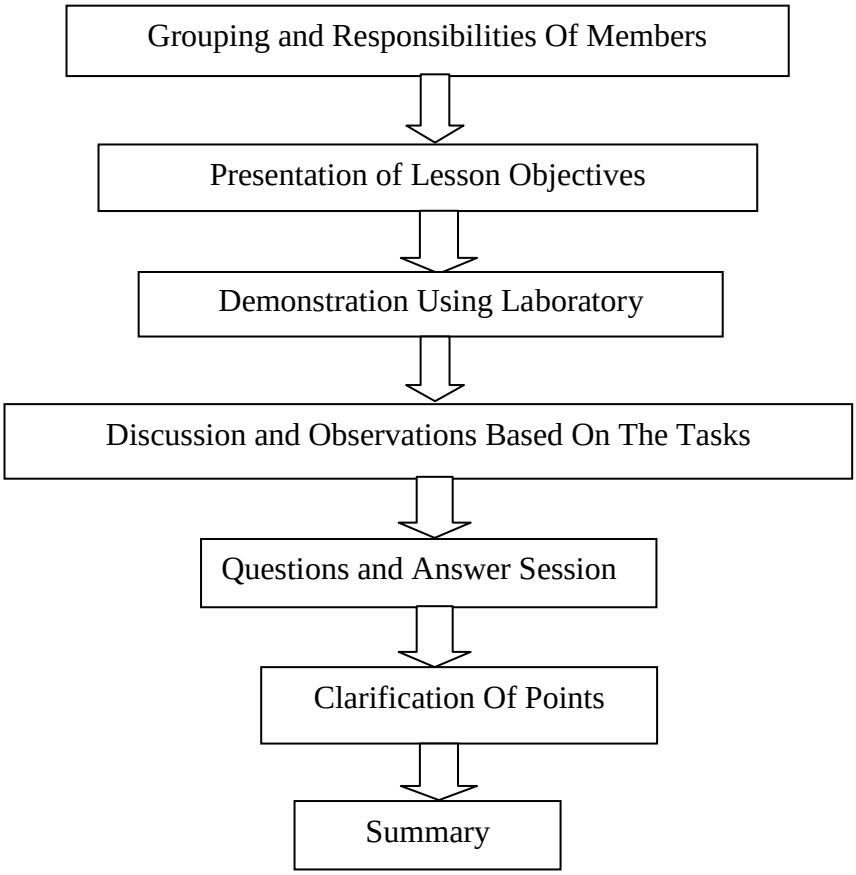

Fig. 3.3: Flow chart of teaching using Enriched Lecture Method (laboratory facilities)
Source: (Adapted from Okeke, 1995)

Control Group II: The group were exposed to teaching using Lecture Method. At the beginning, the teacher introduces the lesson by presenting the objectives of the lesson. This was followed by verbal presentation of contents where students were encouraged to listen and write down note, in addition, after the lesson, the teacher opens a discussion on the lesson. Comments, questions and discussions were entertained and points were clarified.

3.7. Data Collection Procedure.

The availability of Computer Assisted Innstruction and Laboratory Facilities in teaching wave were determined by researcher's observation with the aid of ACAILFQ instrument. The available instrument was ticked on the column of availability (AV). The

number of Computer-Aided Instruction and Laboratory Facilities observed were counted and recorded for analysis. Data for pre and post tests were obtained from students' responses to Wave Performance Test (WPT) instrument by the researcher himself. The items were then subjected to scoring for analysis.

3.8. Procedure for Data Analysis

The Research Questions and null hypotheses raised were answered and tested respectively using infrential and descriptive statistic. Inorder to do this, both Research Questions and hypotheses were restated with their respective statistical tools as follow:

3.8.1 Research Questions:

The following Research Questions were answered using descriptive statistic as follows:

1. Research Question 1 was answered descriptively by comparing the quantity of facilities observed and the population of students taking the proportion/ratio of each Computer-Aided Instruction and Laboratory Facilities used in teaching physics in experimental and control groups and compared with the standard set by WAEC and STAN (5:1).
2. Research Questions 2, 4 and 5 were answered descriptively using mean and standard deviation.
3. Research Questions 3 was answered descriptively using mean rank and sums of rank of post test interest of the students in the subject in experimental and control groups.

3.8.2 Null hypotheses

The following null hypotheses were answered using inferential statistic as follows:

4 Hypotheses 1,3 and 4 were tested using ANOVA with the aid statistical packages for Social Sciences (SPSS) software at $P \leq 0.05$ level of significance.

5 Hypothesis 2 was tested using Kruskal-Wallis with the aid of statistical packages for Social Sciences (SPSS) software at at $P \leq 0.05$ levels of significance.

CHAPTER FOUR

DATA ANALYSIS, RESULTS, AND DISCUSSION

4.1. Introduction

This study examined the impact of Computer-Aided Instruction and Laboratory Facilities on interest and academic performance in wave concept of physics students at Senior Secondary School level in Zaria education zone, Kaduna State. Data were collected using three validated instruments and analysed using mean, standard deviation, t-test, ANOVA and Kruskalwalis' test at alpha ≥ 0.05 using SPSS Software version 17.1. This chapter therefore presented the result, interpretation and discussions of findings under the following subheadings:

- Data Analysis and Result Presentation
- Summary of Findings
- Discussion of Results

4.2. Data Analysis and Result Presentation

Research Question One:

What is the state of availability of Computer-Aided Instruction and Laboratory Facilities for teaching physics at Secondary Schools?

To answer this Research Question, the researcher observed the availability of the facilities in terms of quantity and compared it with standard set by WAEC and STAN which provide a ratio of 5:1 students/facilities ratio. Table 4.1 presented the quantity of Availability of Computer-Aided Instruction and Laboratory Facilities Used in Teaching Physics.

Table 4.1: Availability of Computer-Aided Instruction and Laboratory Facilities

Laboratory Facilities Availability			Computer Ass. Instruction Facilities		
Items	**Qty**	**Ratio**	**Items**	**Qty**	**Ratio**
1. Telescope	20	85:1	1. Computers	85	20:1
2. Sonometer Box	89	19:1	2. Video Clips/Cassets	189	9:1
3. Sonar	36	47:1	3. Projectable Slides	215	8:1
4. Tray	45	38:1	4. Motion Pictures	120	14:1
5. Lamp	41	41:1	5. Internet Connectivity	3	565:1
6. Lenses	220	8:1	6. Television	18	94:1
7. Rectangular Glass	89	19:1	7. Radio/Tape Recorder	20	85:1
Prism	90	19:1	8. Slide Projector	2	848:1
8. Rectangular Glass	220	8:1	9. Flash drive	215	8:1
Block	87	19:1	10. Compact disk	120	14:1
9. Lense Holder	200	8:1	11. Mobile handset	6	283:1
10. Mirror Holder	211	8:1	12. Adobe readers	29	50:1
11. Bulb	218	8:1	13. External CD room	5	340:1
12. Measuring Cylinder	124	14:1	14. LAN	18	94:1
13. Paper	120	14:1	15. Computer desks	88	19:1
14. Drawing Board	189	9:1	16. Computer room	10	170:1
15. Retort Stand	180	9:1	17. Modems	0	0
16. Concave Mirror	200	8:1	18. E-library	212	8:1
17. Convex Mirror	210	8:1	19. USB Cables	2	848:1
18. Ray Box	210	8:1	20. Anti virus softwares		
19. Spiral Spring	10	170:1			
20. Turning Fork	45	41:1			
21. Pin-Hole Camera	53	32:1			
22. Kaleidoscope	212	8:1			
23. Periscope	6	283:1			
24. Optical Instrument	29	50:1			
25. Drum	5	340:1			
26. String	18	94:1			
27. Wind Instrument	88	19:1			
28. Percution	46	41:1			
29. Stop Watch	15	113:1			
30. Resonance Tube	53	32:1			
31. Microscope	85	20:1			
32. Cork	92	18:1			
33. Ripple Tank					
34. Stroboscope					

NB: In all cases, the population of students is 1,696 which is compared with the availability of the facilities.

Facilities are adequate if Students/Facility ratio=5:1; and Not adequate if Students/Facility ratio□ 5:1

The Table 4.1 shows the quantity of Availability of Computer-Aided Instruction and Laboratory Facilities Used in Teaching Physics. When compared to standard set by WAEC and STAN which provide a ratio of 5:1 students/facilities ratio, it is discovered

that none of the facilities are adequate in the schools under study. For example, taking the ratio of availability of lenses which has the highest quantity, it is

discovered that the number of lenses observed is 220 and the population of the study is 1,696 students in which a ratio, of 8:1 (eight students per lense) is observed which deviate from standard set by WAEC and STAN (5:1). This therefore answered the first Research Question which sought to findout whether Computer-Aided Instruction and Laboratory Facilities for teaching physics are available at Senior Secondary Schools of the study area. The Computer-Aided Instruction and Laboratory Facilities are inadequate when compared with standard set by WAEC and STAN (5:1).

Research Question Two: What is the difference in the mean academic performance scores of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method?

Table 4.2: Means and Standard Deviations Scores of Experimental and Control Groups on WPT.

Variable		N	Mean	S.D.	Mean Difference
Experimental G. I:	pretest	68	38.95	9.17	22.86
	Posttest	68	61.81	8.74	
Experimental G.II	Pretest	60	39.11	10.2	13.57
	Posttest	60	52.68	7.87	
Control Group	Pretest	70	40.80	7.8	1.7
	Posttest	70	42.50	8.92	

The Table 4.2 presents the pretest and post test mean scores of students in experimental I, experimental II and control groups. From the result, the pre and post tests score of students in experimental group I were 38.95 and 61.81 with a mean difference of 22.86. The result also shows that the pre and post tests score of students in experimental group II were 39.11 and 52.68 with a mean difference of 13.57. The pre and post tests score of students in Control group were 40.80 and 42.50 and a mean difference of 1.7

was recorded. Students taught wave concept using Computer-Aided Instruction have the highest mean score (61.81), followed by Laboratory Facilities enriched with lecture method (52.68) and lastly Lecture Method group (42.50). Therefore students exposed to wave concept using Computer-Aided Instruction performed better than those exposed to Laboratory Facilities enriched with lecture method and Lecture Method.

Research Question Three: What is the difference in the mean interest of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those exposed to Lecture Method in Senior Secondary Schools of the study area?

Table 4.3: Mean Rank and Sums of Rank of Post test Interest of Students in Experimental and Control Groups

Variable	N	Mean Rank	Sum of Ranks	Mean Diff.
Experimental GI: Pretest	68	38.50	461	25.42
Experimental GI: Posttest	68	63.92	874	
Experimental GII: Pretest	60	39.20	468	12.61
Experimental GII: Posttest	60	51.81	787	
Control Group: Pretest	70	38.80	464	5.7
Control Group: Posttest	70	44.50	892	

The result in Table 4.3 compared the change in interest of students in experimental and control groups. From the result, the pre and posttests mean interest score of Experimental Group I was 38.50 and 63.92, with a difference of 25.42 and the pre and posttests mean interest score of experimental group II was 39.20 and 51.81 with a difference of 12.61, while the pre and posttests mean interest score of control group was 38.80 and 44.50 with a difference of 5.7. Students taught wave concept using Computer-Aided Instruction have the highest mean score, followed by Laboratory Facilities enriched with lecture method and lastly Lecture Method group. Based on the

result presented, there is slight difference between the interests of physics students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method .However, when compared to lecture group, there is remarkable difference in the interest of students towards wave concept. Computer-Aided Instruction and Laboratory Facilities enriched with lecture method were efficacious in engendering students' interest and this answered the third Research Question which stated that ''What is the difference in the mean interest of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those exposed to Lecture Method in Senior Secondary Schools of the study area?''

Research Question Four: What is the difference in the impact of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on male and female students' academic performance when taught wave concept of physics at Senior Secondary Schools of the study area?

Table 4.4: Means and Standard Deviations Scores of Male and Female Students in Experimental Groups I & II

Group/Method	Exp I				Exp II			
	N	Mean	Sd	Mean Diff	N	Mean	Sd	Mean Diff
Male	30	31.22	4.54	0.63	38	27.28	3.87	1.88
Female	38	30.59	4.20		22	25.40	4.00	

The result in Table 4.4 reveals that the post test mean score of male and female students in experimental group I were 31.22 and 30.59 with a mean difference of 0.63. This shows that Male Students taught wave concept using Computer-Aided Instruction have the highest mean score than female. However, the difference is slight. In the experimental group II, male and female students have a mean score of 27.28 and 25.40 with a difference of 1.88. The result shows that male Students taught wave concept using Laboratory Facilities enriched with lecture method have the highest mean score than

female. The answer to the Research Question number four that asked ‘’What is the impact of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on male and female student’s academic performance when taught wave concept of physics at Senior Secondary Schools of the study area?’’ is that there is slight difference in the performance of male and female students in the two groups, with male students having highest score.

Research Question Five: What is the difference in the mean academic performance scores of male and female students’ taught wave concept of physics using Lecture Method ín Senior Secondary Schools of the study area?

Table 4.5: Means and Standard Deviations Scores of Male and Female Students in Control Group.

Variable	N	Mean	SD	Mean Diff.
Male	33	29.41	5.02	16.32
Female	37	13.09	3.90	

The result in Table 4.5 presented the post test mean score of male and female students taught wave concept using Lecture Method. The result reveals that mean score of male students is 29.41and that of female students is 13.09 and a mean difference of 16.32 was observed in favour of male students. The result shows that Male Students taught wave concept using Lecture Method have the highest mean score than female students. Accordingly, there is slight difference in the mean academic performance scores of male and female student’s taught wave concept of physics using Lecture Method ín Senior Secondary Schools of the study area in favor of males.

Testing Null Hypotheses

Null Hypothesis One (H_{01}): There is no significant difference between the mean academic performance score of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the

same concept using Lecture Method. In order to test this hypothesis, Analysis of Variance was run using SPSS software version 17.1 and the result was presented in Table 4.6.

Table 4.6: ANOVA for the differences in Performance of students in Experimental and Control Groups

Source of variation	Sum of squares	DF	Mss	F-ratio	P	Remark
Between groups	633.54	1	633.54			
Within groups	842.33	2	421.34	103.41	0.01	Sig.
Total	1475.87	3				

Fcal=103.41; F crit=24.31. F calculated □ F Critical at 0.05 level of significant.

From the result in Table 4.6, Sum of squares between groups were found to be 633.54 and Sum of squares within groups are 842.33. An f-ratio of 103.41 was calculated and p.value of 0.01 was obtained. Since the p-value of 0.01 is less than 0.05, there is a significant difference. The null hypothesis one was rejected and there is significant difference between the mean academic performance of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method. Scheffers post-hock test was further conducted from the result of ANOVA using SPSS to determine the source and direction of varience and the result obtained was presented in Table 4.7.

Table4.7: Scheffe Test for Direction of difference in Performance of students in Experimental and Control Groups

N_1	N_2	N_3	X_2	Msw	F	Fcal	F^1
68	**60**	**70**	**18.3**	**421.34**	**29.5**	**24.31**	**8.24**

Fcal=24.31 Fvalue required for significant (F^1) =8.24. F Value to be significant at 0.05 level, HO_1 rejected.

Table 4.7 presented the source of varience in the mean academic performance score of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method (experimental groups) and those taught the same

concept using Lecture Method (control group). The test revealed the direction of difference in favor of experimental groups.

Null Hypothesis Two (H_{O2}): There is no significant difference in the interest of physics students taught wave concept using Computer-Aided Instruction and enriched lecture method and Lecture Method at Senior Secondary Schools of the study area.

The data collected were analysed using Kruskalwallis and presented as follows:

Table 4.8: Kruskalwallis Test for the Difference in Students' Interest in Experimental and Control Groups

Variable	N	Mean Rank	Sum of Ranks	H-Value	P	Remark
Experimental G1	68	63.92	874			
Experimental GII	60	51.81	787	851	0.01	Sig.
Control Group	70	44.50	892			

The result in Table 4.8 compared the change of interest of students in experimental and control groups. The result shows that the Experimental Group I, Experimental Group II and the control groups have mean rank values of 63.92, 51.81 and 44.50 respectively. The Kruskalwallis observed was 851.00 and the p-value observed was 0.01. Since the p-value of 0.01 is less than 0.05, there is a significant difference in the interest of students in wave concept due to exposure to treatment. Therefore the null hypothesis that states that there is no significant difference in the interest of physics students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and Lecture Method at Senior Secondary Schools of the study area was rejected.

Since significant difference exists between the three groups, there is a need to determine the source or direction of the differences. Based on the for going, Scheffers post-hock test was further conducted from the result of H-test using SPSS to determine the source and direction of varience and the result obtained was presented in Table 4.9.

Table 4.9: Scheffe Test for Direction of Gap in the Interest of Students in Experimental and Control Groups

N_1	N_2	N_3	X_2	Msw	F	Fcal	F^1
68	**60**	**70**	**11.2**	**21.34**	**3.5**	**13.1**	**5.8**

Table 4.9 presented the source of varience in the interest score of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method (experimental groups) and those taught the same concept using Lecture Method (control group). The test revealed that students taught wave concept using Computer-Aided Instruction (experimental groupI) generate higher interest, followed by students taught wave concept using Laboratory Facilities enriched with lecture method (experimental groupII) and finally students taught wave concept using Lecture Method (control group). The direction of difference is in favor of experimental groups.

Null Hypothesis Three (H_{O3}): There is no significant difference between the mean academic performance scores of male and female students taught wave concept of Physics using Computer-Aided Instruction and those taught the same concept using Lecture Method only at Senior Secondary Schools of the study area.

To test this hypothesis, there is a need to present t-test analysis of experimental group I and control group separately to see the performance of gender in all cases and is presented in Table 4.10 (A&B).

Table 4.10(A): t-test analysis of Male and Female Students in Experimental Group I

Variable/Group	N	Mean	SD	df	T	P	Remark
Male	30	31.22	4.5	66	1.98	0.06	Not significant
Female	38	30.59	4.2				

*Not significant at P≥ 0.05

From the result presented in Table 4.10(A), t-value observed was 1.98, while the p-value observed is 0.06 which is greater than alpha value. This shows that there is no significant

difference in the performance of gender exposed to wave concept using Computer-Aided Instruction. The null hypothesis is rejected.

Table 4.10(B): t-test analysis of Male and Female Students in Control Group

Variable/Group	N	Mean	SD	Df	T	P	Remark
Male	33	29.41	5.02	68	28.6	0.01	significant
Female	37	13.09	3.90				

*significant at P≤ 0.05

From the result presented in Table 4.10(B), t-value observed was 28.6, while the p-value observed is 0.01 which is less than the alpha value. This shows that there is significant difference in the performance of gender exposed to wave concept using lecture method in favour of male students as indicated by their mean score.

Consequently, there is no significant difference between the performances of male and female students exposed to Computer-Aided Instruction. However, significant difference exists between the performances of male and female students exposed to lecture method in favour of male students.

H_{O4}: There is no significant difference between the mean academic performance scores of male and female students taught wave concept of Physics using Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method only at Senior Secondary Schools of the study area.

Table 4.11(A): t-test analysis of Male and Female Students in Experimental Group II

Variable/Group	N	Mean	SD	df	T	P	Remark
Male	38	27.28	3.87	58	1.98	0.08	Significant
Female	22	25.40	4.0				

*Not significant at P≥ 0.05

From the result presented in Table 4.11(A), t-value observed was 1.98, while the p-value observed is 0.08 which is greater than alpha value. This shows that there is no significant difference in the performance of gender exposed to wave concept using Laboratory

Facilities. To establish whether difference exist in the other group, the result of performance of male and female students was further subjected to t-test and presented in Tabl 11(B).

Table 4.11(B): t-test analysis of Male and Female Students in Control Group

Variable/Group	N	Mean	SD	df	T	P	Remark
Male	33	29.41	5.02	68	28.6	0.01	significant
Female	37	13.09	3.90				

*significant at P≤ 0.05

From the result presented in Table 4.11(B), t-value observed was 28.6, while the p-value observed is 0.01 which is less than the alpha value. This shows that there is significant difference in the performance of gender exposed to wave concept using lecture method in favour of male students as indicated by their mean score. As a result, there is no significant difference between the performances of male and female students exposed to Laboratory facilities. However, significant difference exists between the performances of male and female students exposed to lecture method in favour of male students.

4.3. Discussion of Results

The results in Table 4.1 show the quantity of Availability of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method Used in Teaching Physics. When compared to standard set by WAEC and STAN which provide a ratio of 5:1 students/facilities ratio, it was discovered that none of the facilities are available in the schools under study. For example, taking the ratio of availability of lenses which has the highest quantity, it was discovered that the number of lenses observed is 220 and the population of the study is 1,696 students in which a ratio, of 8:1 (eight students per lense) was observed which deviate from standard set by WAEC and STAN (5:1). This study is in comformity with previous studies conducted in other field such as Biology

and Geography. For instance, Abdulkarim (2010) conducted on assessment of facilities for teaching geography in Secondary schools of Kaduna state revealed inadequacy of the teaching facilities.

From Table 4.6, an F- ratio of 103.41 was calculated and found to be significant at 0.05. The null hypothesis was rejected and there is significant difference between the mean academic performance of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method. Table 4.7 presented the source of varience in the mean academic performance score of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method (experimental groups) and those taught the same concept using Lecture Method (control group). The test revealed the direction of difference in favour of experimental groups. This shows that physics students taught wave concept using Computer-Aided Instruction and enriched lecture method performed better than their counterpart taught the same concept using Lecture Method only. The finding is in congruence with that of previous researches such as Olaniyi (2006), who observed that Computer-Aided Instruction such as internet system gives students access to wide range of information and knowledge about environment, socio-cultural, economic and other aspects of life of the people in various parts of the world. Other studies that shares similar view include that of researchers like (Folorunso, Longe, & Ijere, 2003, Kingsley, 2011 & Josiah, 2012). Kingsley, (2011) ascertained that computer has dominated human activities especially in the last two decades. Its use is complemented by a whole lot of other electronic devices, all of which are now collectively regarded as Computer-Aided Instruction. Josiah, (2012) maintained that Computer-Aided Instruction has an edit effect in terms of quality of student work and practical examples through visualisation; improves poor handwriting

and languages skills through word processing; equalises individual differences and has particularly dramatic effects for students with special needs; facilitates self-pacing with increased capacities to deal with individual learning styles as students can work at the pace and intensity suitable to their needs; enables collaborative learning with little indication of the isolated learner; encourages use of peer coaching and peer reviews; develops communication skills and awareness of different audiences; has impact on resource–based learning and access to real world information through the Web; increases student motivation through hands-on activity, visual representations and improved modes of presentation; encourages independent learning and individual preferences for process, layout, style and format; has enhanced performance due to the reinforcement and practice that Computer-Aided Instruction has afforded, among others.

The result in Table 4.8 compared the change of interest of students in experimental and control groups. The result reveals that the Experimental Group I, and II and the control group have mean rank values of 63.92, 51.81 and 44.50 respectively. The Kruskalwallis observed was 851.00 and the p-value observed was 0.01. Since the p-value of 0.01 is less than 0.05, there is a significant difference in the interest of students in wave concept due to exposure to treatment. Therefore, the null hypothesis that states that there is no significant difference between the interest of physics students' taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and Lecture Method at Senior Secondary Schools of the study area was rejected. Table 4.9 presented the source of varience in the interest score of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method (experimental groups) and those taught the same concept using Lecture Method (control group). The test revealed that students taught wave concept using Computer-Aided Instruction (experimental groupI) generate higher

interest, followed by students taught wave concept using Laboratory Facilities enriched with lecture method (experimental groupII) and finally students taught wave concept using Lecture Method (control group). The direction of difference is in favor of experimental groups.

The finding is supported by previous studies on gender and interest. For example, Obeka (2010), revealed no significant difference in the interest ability of male and female students in environmental education concepts of geography due to exposure to demonstration and inquiry teaching methods. Mari (2010), study on entry qualification and performance revealed that male and female students admitted with the same entry qualification have no difference in their performance.

The result in Table 4.10(A) and 4.11(A) revealed that there is no significant difference between the mean academic performance scores of male and female students taught wave concept of Physics using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method. The two strategies are gender friendly. However, there exist significant difference between the mean academic performance scores of male and female students' taught wave concept of Physics using Lecture Method only. Male and female students exposed to Computer-Aided Instruction and Laboratory Facilities enriched with lecture method did not differ significantly, but there exists significant different between the performance of male and female students exposed to Lecture Method.

The findings supported the previous studies such as that of Bichi (2002), Usman (2010), Mari, (2010), Atadoga and Lakpini (2013) who in their separate studies found that innovative teaching strategies with integrated resource materials enhance students' performance irrespective of gender. Usman (2010), further supported the result of finding in his study "relationship between students' performance and their academic

performance in Biology using NISTEP mode of teaching who revealed that senior secondary male and female biology students will not differ significantly in their performance when exposed to innovative strategies. Furthermore, in the discipline of geography, Obeka (2008), revealed that the use of innovative strategies in environmental education concepts of geography proved to be effective in enhancing the performance of male and female students and are gender friendly.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter presents the summary, findings, conclusion and recommendations of the study under the following sub-headings:

- Summary
- Conclusion
- Contribution to knowledge
- Recommendations
- Limitations of the Study
- Suggestions for further Studies

5.2. Summary

This study investigated the impacts of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on Senior Secondary School Physics students' interest and academic performance, in Wave concepts and presented in five chapters.

The chapter one focuses on the background, theoretical framework, and statement of the problem of this study. The study have five research objectives among which sought to determined the availability of Computer-Aided Instruction and laboratory facilities for teaching physics in Senior Secondary Schools of the study area, and examined the impact of the three strategies on the academic performance and interest of students exposed to wave concept of physics.

The study was guided by five Research Questions and four null hypotheses. It was found significant to teachers, students, textbook publishers, other researchers and Curriculum planners such as NAERDC to use the outcomes of this study, design and

include programmes in the physics curriculum that are in line with Computer-Aided Instruction and Laboratory Facilities enriched with lecture method to aid meaningful learning in schools.

The study was delimited to investigation of the impact of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on academic performance and inerest in wave concept of physics students using Senior Secondary (SSII) students in public Senior Secondary Schools offering physics in Zaria education zone.

The chapter two reviewed literatures related to this study on; Concept of Physics as a Discipline in Science Education; Methods of Teaching Physics at Senior Secondary School level; Computer-Aided Instruction in Science Education; Types of Computer-Aided Instruction Facilities in Physics; Using Computer-Aided Instruction in Teaching Senior Secondary School Physics; Challenges of Curriculum Implementation of Computer-Aided Instruction in Physics Education; Laboratory Facilities enriched with lecture method and Academic Performance; Interest and Academic Performance in Science Education; Gender and Academic Performance in Science Education; Overview of Similar Studies and Implication of the Literatures Reviewed on the Present Study.

The chapter three presented the methodology of the study. Two research designs: namely, Survey and Quasi-experimental-control group designs involving pre-and post-tests were used in this study. The population of this study covered all public Senior Secondary Schools with population of one thousand six hundred and ninety six (1,696) year II physics students as at 2013/15 academic session in Zaria education zone. Details were summarized in Table 3.1. The sample of the study covered a total number of 198 SS II students from three public Senior Secondary Schools of Zaria educational zone randomly selected using systematic sampling technique. Three validated instruments

developed by the researcher namely; Availability of Computer-Aided Instruction and Laboratory Facilities Questionnaire (ACAILFQ), Wave Performance Test (WPT) and Wave Interest Inventory Questionnaire (WIIQ) with reliability coefficient of 0.78 for ACAILFQ, 0.70 for (WPT) and 0.87 for (WIIQ) were used for the study.

The chapter four presented the result, analysis and discussions. Research Questions raised were answered using descriptive statistic while null hypotheses were tested with inferential statistic. Result of findings shows that most of the Computer-Aided Instruction facilities and Laboratory Facilities are inadequate compared to students' population and the standard set by WAEC and STAN. Furthermore, there is significant difference between the mean academic performance of students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method. Also, there is significant difference between the interest of physics students taught wave concept using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and Lecture Method at Senior Secondary Schools of the study area. Similarly, the findings shows no significant difference between the mean academic performance scores of male and female students taught wave concept of Physics using Computer-Aided Instruction and those taught the same concept using Lecture Method only at Senior Secondary Schools of the study area.

The chapter five presented the summary, findings, conclusion and recommendations of the study. It also made some recommendations and suggestions for further studies.

5.3. Summary of the Major Findings

From the result obtained in this study, the major findings include the followings:

1. There is significant difference in the academic performance scores of Physics students taught Wave concepts using Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and those taught the same concept using Lecture Method in favor of the subjects in the experimental groups than control group.
2. There is a significant difference in the interest of students in Wave concept as a result of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method and Lecture Method. The significant difference is in favour of experimental group.
3. There is no significant difference in the academic performance of male and female students exposed to Computer-Aided Instruction in Wave concept.
4. There is no significant difference in the academic performance of male and female students exposed to Laboratory Facilities enriched with lecture method in Wave concept.

5.4. Conclusions

Based on the findings from this study, it is concluded that:

1. Computer Aided Instruction and Laboratory Facilities for teaching physics are inadequate in secondary schools of the study area.
2. Students taught Wave concepts using Computer-Aided Instruction and enriched lecture method performed better than those taught the same concept using Lecture Method only.
3. Students taught Wave concepts using Computer-Aided Instructios and enriched lecture method developed interest in physics than Lecture Method group.

4. The use of Computer-Aided Instruction in teaching Wave concept is gender friendly.
5. There is difference in the academic performance of male and female students exposed to lecture method in Wave concept.

5.5. Contrubution to Knowledge

The following were the contributions of this study to knowledge:

1 The researcher developed Computer-Aided Instruction package and lesson plan as guides for teaching Wave concepts. The instructional facilities were found to be gender friendly.

2 The study was able to establish that the use of Computer-Aided Instruction is capable of improving academic performance of students in wave concept of physics regardless of gender.

3 The study was able to establish that both the use of Computer-Aided Instruction and Laboratory Facilities enriched with lecture are capable of arousing the Interest of students in wave concept of physics.

5.6. Recommendations

Based on the findings of this study, the researcher recommended that:

1. The Federal and state ministry of education should ensure availability of Computer-Aided Instruction facilities in all secondary schools of the study area.
2. The Federal Government of Nigeria through State Ministries of Education should collaborate with professional bodies such as STAN and train teachers through workshops, and seminars on using Computer-Aided Instruction in teaching physics at Secondary School.

3. Teacher Training Institutions such as Universities and colleges of Education as well as curriculum development bodies like NAERDC should introduce compulsory practical work using computers to secondary schools pre-service teachers and teachers undergoing in-service training before graduation.

5.7 Limitations of the Study

In the course of conducting this study, the researcher accepted the following as limitations to the study:

i. The study used secondary school students. If for example, the study covered up to tertiary levels of education, the outcomes may be different from the present findings. Hence, the researcher considered it as limitation to this study which may affect the generalization of the study.

ii. Constant power failure by Power Holding Compony of Nigeria.

5.8 Suggestions for Further Study

From the findings of the study the researcher made the following suggestions:

1. There is a need for other researchers to conduct research on effectiveness of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on physics academic performance and interest among university students in Northwestern Nigeria.
2. There is a need for other researchers to conduct research on comparative analysis of the effect of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on students' performance in electrolysis concept in physics.
3. There is a need for other researchers to conduct research on availability, utilization and relative effectiveness of Computer-Aided Instruction and Laboratory Facilities enriched with lecture method on retention and performance among learners of varied abilities.

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APPENDIX A

QUESTIONNAIRE
AVAILABILITY OF LABORATORY FACILITIES (ALFQ)

Dear Respondent,

The bearer of this research instrument is a masters student in the departement of science education, ABU Zaria. The items presented are design to examine availability of Laboratory Facilities in teaching Senior Secondary physics. You are therefore requested to respond to the questionnaire items. You are guaranted an utmost confidentiality as the information provided were used strictly for this research only. Please take note of the following keys:

Av = available
NA = not available
Q = Quantity

SECTION B: Please mark (√) in the appropriately column of your choice.

Items	**AV**	**NA**	Q
1 Ripple tank			
2 Stroboscope			
3 Telescope			
4. Sonometer box			
5. Sonar (echo sounding devices)			
6. Tray			
7. Lamp			
8. Lenses			
9. Rectangular glass prism			
10. Rectangular glass block			
11. lense holder			
12. mirror holder			
13. bulb			
14. measuring cylinder			
15. paper			
16. Drawing board			
17. Retort stand			
18. Concave Mirror			
19. Convex Mirror			
20. Ray box			
21. Spiral spring			
22. Turning fork			
23. Pin-hole camera			
24. Kaleidoscope			
25. Periscope			
26. Optical instrument			
27. Drum			
28. String			
29. Wind instrument			
30. Percution			
31. stop watch			
32. resonance tube			
33. microscope			
34. cork			

APPENDIX B

WAVE CONCEPT PHYSICS PERFORMANCE TEST (WCPAT)

SECTION A: PERSONAL INFORMATION

Name of School…….

Class…….....

Gender: Male [ ] Female [ ]

Age…….....

SECTION B

Instruction

Please read the following instructions carefully and answer the questions that follow:

1. Write your school name, class, age and gender in the space provided in the answer sheet.
2. Read each question carefully before answering it. If you find a question difficult, go on to the other questions and finish them first.
3. Select only one answer for each equestion.

Now Answer The Following Questions By Underlining The Correct Answer And Shade Appropriate Letter In The Answer Sheet Provided For The Exam.

1. A disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium is called…….

(a) Motion

(b) Acceleration

(c) Momentum

(d) Wave

2. The process involved in the transfering of disturbance which travels through a medium transferring energy from one point to another without any transfer of particles of the medium is termed as

(a) Wave long

(b) Wave Change

(c) wave motion

(d) WavelengthNever changes throughout

3. All waves have their source as.....

(a.) vibration

(b) liquid

(c) solid

(d) gas

4. In wave motion, what kind of energy is applied?

(a). potential

(b). mechanical

(c). kinetic

(d). sound

5. All the following are types of waves in physics except.....

(a) Mechanical

(b) Electromagnetic

(c) sun

(d) Transverse

6. A wave that requires a material medium for their propogation is.....

(a) mechanical

(b) Electromagnetic

(c) sun

(d) Transverse

7. A type of wave that do not required a material medium for their propogation is.....

(a) Mechanical

(b) Electromagnetic wave

(c) Sun

(d) Transverse wave

8. Which of the following is an example of electromagnetic wave

(a) Radio Waves

(b). Sound waves

(c). Water waves

(d). Waves on string

9. X-rays and gamma rays are example of.....

(a) Mechanical

(b)Electromagnetic

(c) Sun

(d) Transverse

10. Wave consists of------- that moves whithout carrying matter with them

(a) Oscillations

(b) Mechanism

(c) Solidification

(d) Vectors

Pick either Yes or No for the Statements in questions 11 to 15

11. Not all waves require a medium for their propogation

Yes [ ] No [ ]

12. Light waves, radio waves, x-rays and gamma rays are forms of mechanical wave

Yes [ ] No [ ]

13. Waves can move over large surface but the medium itself has only a limited movement.

Yes [ ] No [ ]

14. A line or surface in the path of an advancing wave on which all the particles are vibrating in step or in phase is wave front

Yes [ ] No [ ]

15. A pulse in wave is a sudden increase in magnitude of a physical quantity, shortly followed by a rapid decrease

Yes [ ] No [ ]

16. An instrument in the laboratory where water waves can be produced and studied is called.....

(a). wave tank

(b). water tank

(c). ripple tank

(d). stroboscope

17. When the dipper of the ripple tank is in the form of horizontal metal or wooden strip.....waves are formed.

(a). Parallel plane

(b). Vertical plane

(c). Spherical plane

(d). Circular plane

18. Circular waves are produced when the dipper is in the form of.....

(a). Horizontal metal

(b).Wooden strip

(c). Sphere

(d). Transverse

19. A wave which travel in a direction parallel to the vibration of medium is called.....

(a). Transverse wave

(b). Longitudinal wave

(c). Horizontal wave

(d). Vertical wave

20. The time taken by a wave particle to make one complete oscillation is called....

(a). Frequency

(b). Amplitude

(c). Wave length

(d). Period

21. The number of complete vibrations or cycles that a particle makes in one second is called.....

(a). Frequency

(b). Amplitude

(c). Wave length

(d). Period

22. The distance between two successive troughs is called.....

(a). Frequency

(b). Amplitude

(c). Wave length

(d).Period

23. The maximum displacement of a particle from its rest position is called

(a). Frequency

(b). Amplitude

(c). Wave length

(d). Period

24. In the application of wave, diffraction is the ability of wave to.....

(a). Stick around path in the obstacles

(b). To bend around path in their obstacle

(c). To bend around obstacle in their path

(d). To move around obstacle outside their path

25. Which of the following is not a property of wave

(a). Polarization

(b). Diffraction

(c). Interference

(d). Reflecation

26. An angle which the direction of motion of a plane wavefront makes with the normal to the metal surface is known as angle of.....

(a). Reflector

(b). Incidence

(c). Reflection

(d). Convex

27.The freequency of a vibrating source is 450Hz and the velocity of the sound it produces in air is $330ms^{-1}$find how far the soundtravels when the source completes 50 vibrations.

(a). 26.67km

(b).67.26km

(c). 36.67km

(d). 58.89km

28. A radio station broadcasts at frequency of 300 kHz. If the speed of the wave is $3 \times 10^{8}ms^{-1}$, calculate the period and wave length of the wave.

(a). 5km

(b). 2km

(c). 1km

(d).11km

29. A plane progressive wave is represented by the equation y = sin (200Meanr-0.5x)what is the frequency of the wave?

(a). f = 100Hz

(b).f = 1100Hz

(c).f = 1000Hz

(d).f = 1010Hz

30. The law of reflection states that, angle of.....is equal to.....

(a). Incidence, reflections

(b). Reflection, perfection

(c). Perfection, incidence

(d). Incidence, perfection

31. A node is a point on a stationary wave where there is.....of the medium.

(a). Movement

(b). Speed

(c). No movement

(d) Slow

32. Constructive interference occurs in the region where.....from the two waves overlap.

(a). Diffractors

(b). Troughs

(c). Interference

(d). Constructors

33..... is the effect produced when two waves of the same frequency, amplitude and wavelength travelling in the same direction in a medium are superposed as they simultaneously pass through a given point.

(a). Interference

(b).Reflection

(c). Perfection

(d). Defrences

34. One of the best example of sound wave is.....

(a). Water

(b). Radio

(c). Light

(d). Polarization

select either yes or no for the following statement onpractical applications of wave

35. The polaroid is used in sun glasses to reduce the intensity of incident light.

Yes [ ] No [ ]

36. Polorised light can be produced using tourmaline crystals, quartz or ploride.

Yes [ ] No [ ]

37. Wave reflection can affect transportation in the day light.

Yes [ ] No [ ]

38. Which of the following bestly describe reletionship between frequency, wavelength and velocity.

(a).$v = v\lambda$

(b).$v = f\lambda$

(c).$g = f\lambda$

(d).$u = f\lambda$

39. The relation $Y = A\sin\frac{2Meanx}{\lambda}$ mathematically represents.....

(a). Wave length

(b). Wave equation

(c). Reflection

(d). Deflection

40. A plane progressive wave is represented by the equation y = 2sin(1000Meanr – 0.5x) where the symbols have their usual meanings. What is the frequency of the wave?

(a). f = 500Hz

(b).f = 100Hz (c).f = 800Hz (d).f = 1000Hz

APPENDIX C
MARKING SCHEME FOR WAVE CONCEPT PHYSICS PERFORMANCE TEST

1. D
2. C
3. A
4. C
5. C
6. A
7. B
8. A
9. B
10. A
11. YES
12. NO
13. YES
14. YES
15. YES
16. C
17. A
18. C
19. B
20. D
21. A
22. C
23. B
24. C
25. D
26. B
27. C
28. A
29. C
30. A
31. C
32. B
33. A
34. B
35. YES
36. YES
37. YES
38. B
39. B
40. A

Total: 1 mark x 40 = 40marks

APPENDIX D
WAVE CONCEPT PHYSICS INTEREST INVENTORY QUESTIONNAIRE (WCPIQ)

Dear Respondent,

The bearer of this research instrument is a masters student in the departement of science education, ABU Zaria. The items presented are design to examine the degree of your interest in wave concepts of Senior Secondary physics. You are therefore requested to rate yourself on the questionnaire items. You are guaranted an outmost confidentiality as the information provided were used strictly for this research only. Please take note of the following keys:

S.A……Strongly Agreed
A……Agreed
U……Undecided
D……Disagreed
S.D…….Strongly Disagreed

Thank You.
MUSA BELLO

SECTION A: PERSONAL INFORMATION

Name of School…….
Class…….....
Gender: Male [ ] Female [ ]
Age…….....

SECTION B: Please mark (√) in the appropriately column of your choice.

S/N	ITEM	S.A	A	U	D	S.D
1.	I am not interested in listening to wave concepts.					
2.	Wave motion and its particles is not useful.					
3.	Understanding of wave concept can help in reducing accident rate cause by mirage.					
4.	I am interested in discussing the effects of wave in practical experiences.					
5.	Wave concept should be removed from physics curriculum.					
6.	I am always attending to a class where wave concept is taught.					
7.	Studying wave concept is too difficult for me therefore i hate it.					
8.	In planning for a journey, sufficient knowledge on wave is very useful.					
9.	I like period in physics when there is wave concepts in it.					
10.	I dont like any aspect of physics involving wave concept					
11.	I sometime remind my teacher when it is time for physics lesson.					
12.	Students should be exposed to wave concepts at primary and secondary level					
13.	Practical aspect of wave concept is interesting.					
14.	Properties of wave such as reflection and refraction comform to the reality, thus i am interested in it.					
15.	The ripple tank aspect of wave concept is confusing.					
16.	The calculations involved in wave concept is difficult to learn.					
17.	Students, irrespective of their field, should be made to study the behavior of waves and its application in life.					
18.	Wave concept of physics is not useful in all aspect					
19.	Due to my interest in wave concept, i observe the behaviour of mirage during any journey.					
20.	I like participation in tutorials organised by my classmate on wave concept					

APPENDIX E
LESSON PLAN FOR EXPERIMENTAL GROUP I
(COMPUTER-AIDED INSTRUCTION)
WEEK ONE

Week:	One
Class:	SS II
Sex	Mixed
Average age:	17 years
Subject:	Physics
Topic:	Concept of Wave
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. Define the terms wave. 2. State an example of waves
Previous knowledge:	Students were aware of occurrences of natural phenomena occurring in the environment such as mirage, vibration etc.
Instructional materials:	CD, Computer
Introduction:	The teacher put on the set of computer to play films of object in motion such as snake, electric soldering, moving water among others to reflect Transverse wave, longutudinal waves, Electromagnetic waves and Mechanical waves and asks students to narrate their experience based on their observations and asked some questions based on what they observed during visualization process. Students will then be Grouped into sets of 5 and assigned Responsibilities of Members in the group.
Presentation Step 1:	At this stage, the Lesson Objectives will be presented. This is followed by Computer Presentation and Group tasks. In the presentation, the concepts and terminologies associated with wave were elaborated using the computers of each group. Such elaboration includes: Definition of the concept of wave. Example: 1. Wave is a disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium Examples of waves. Terminologies associated with wave concepts • amplitude • period • wave length • Wave velocity .
Step 2:	Discussion and Observation Based On The Media Presentation by

Step 3	group members
Evaluation	Questions and Answer Session: each group raised question to other groups to be responded by members of that group At this stage the teacher interacts with students in Clarification of Points and issues raised by members of groups followed by general questions on the concepts learned.
Conclusion	Example: What is wave? List three terms associated with wave concept. The lesson was concluded by giving board Summary and ask students to copy the note in their books.

WEEK TWO

Week:	Two
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Types of Wave
Behavioral:	By the end of the lesson, students should be able to:
objectives:	1. State the types of waves. 2. Explain each type of wave 3. State examples of each wave type 4. Define wave motion
Previous knowledge:	Students have learnt the definition of wave concept.
Instructional materials:	CD, Computer
Introduction:	The teacher put on the set of computer to play films of object in motion such as snake, electric soldering, moving water among others to reflect Transverse wave, longutudinal waves, Electromagnetic waves and Mechanical waves and asks students to narrate their experience based on their observations and asked some questions based on what they observed during visualization process. Students will then be Grouped into sets of 5 and assigned Responsibilities of Members in the group.
Presentation: Step 1:	At this stage, the Lesson Objectives will be presented. This is followed by Computer Presentation and Group tasks. In the presentation, the concepts and terminologies associated with wave will be elaborated using the computers of each group. Such elaboration includes: types of waves. Example: 1. Transverse wave Longutudinal waves. Electromagnetic waves Mechanical waves e.tc
Step 2:	Group Discussion and Explanation of waves types Example: Electromagnetic waves is a type of wave that do not required a material medium for their propogation Mechanical waves is a type of wave that required a material medium for their propogation

Examples of wave types;

1. Electromagnetic wave: light waves, radio waves, x-rays and gamma rays.
2. Mechanical waves: water waves, sound waves, waves on a rope or string

Evaluation: Wave motion process involve in the transfering ofdisturbance which travels through a medium transferring energy fromone point to another without any transfer of particles of the medium

The teacher asks students to narrate an experience they learn while viewing computer programme to differentiate wave types.

Conclusion: The teacher evaluates the lesson by asking students some questions based on the lesson treated.

Example:

- What are the types of wave?
  What are the examples of mechanical wave?
  What is wave motion?

The teacher presents the summary of the lesson while students jot down in their books.

WEEK THREE

Week: THREE
Class: SS II
Sex: Mixed
Average age: 17
Subject: Physics
Topic: Terminologies associated with wave concept
Behavioral objectives: By the end of the lesson, students should be able to:

1. Explain terminologies associated with wave concept:
   A. Cycle
   B. Frequency
   C. Wave length
   D. Period
2. State the relationships between frequency, wavelength and velocity

Previous knowledge: Students have learnt about the types of wave.

Instructional materials: CD, Computer

Introduction: Visualization, Grouping and Responsibilities of Members: The class will be presented with a short visualization of long strings, and a long air in pipes and ask students to observed and comment on the presentation following the teachers questions to link their experience with the present lesson.

Presentation: The lesson will be presented based on the following steps:

Step 1: The teacher explains to the students the objectives of the lesson.

Step 2: The teacher plays the instructional computer for students to listen and observe the narrations. In the narration number one, the instructional computer itemised the terminologies associated with wave concept.
Example:

A. Amplitude
B. Cycle
C. Frequency
D. Wave length
E. Period

Step 3: Explanation of terminologies associated with wave concept
Example:

1. Amplitude is the maximum displacement of a particle from its rest position

2. The time taken by a wave particle to make one complete oscillation is period e.tc

Step 4: Relationships between frequency, wavelength and velocity.
Velocity = frequency x wave length

a. Wave length

Students'

activity $V = \frac{\text{distance travelled by wave}}{corresponding\ time\ taken}$

Evaluation:

Computer/Video Presentation + Group Tasks: The teacher asks students to narrate an experience they learn while viewing computer programme to relate terminologies of waves.

The teacher evaluates the lesson by asking students some questions based on the lesson treated.
Example:

- Explain the following terms:
  b. Cycle
  c. Frequency
  d. Period

  What is the mathematical relationship between frequency, wavelength and velocity?

Conclusion:

The teacher presents the summary of the lesson while students jot down in their books.

WEEK FOUR

Week:	FOUR
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Properties of waves
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. State the properties of wave 2. Explain refraction and polarization 3. Differentiate between angle of incidence and angle of reflection
Previous knowledge:	Students have learnt about the terminologies of wave concept.
Instructional materials:	CD, Computer
Introduction:	Visualization, Grouping and Responsibilities of Members: The lesson will be presented by playing to students a short film of waves showing mirage, electronic sewing machine and termite movement to relate to the topic to be taught.
Presentation:	The lesson will be presented based on the following steps:
Step 1:	The objectives of the lesson will be made known to students.
Step 2:	Computer Presentation + Group Tasks The students play the computer to listen and observe the narrations. In the narration number one, the computer itemised the Properties of wave. Example: a. Refraction b. Reflection c. Interference d. Diffraction e. Polarization
Step 3:	Discussion and Observation Based on the Media Presentation related to explanation of the Properties of wave. Example: Refraction is the change in speed and direction of the waves as they cross the boundary pass from the medium. Differences between Angle of incidence and angle of reflection angle of incidence is the angle which the direction motion of the plane wavefront makes with the normal to the metal surface. Angle of reflection is the angle between the direction of motion of the reflected wavefront and normal OP to the plane surface. etc

Students' activity:	The students will be asked to narrate an experience they learn while viewing computer programme to relate terminologies of waves.
Evaluation:	The lesson will be evaluated by asking students some questions based on the lesson treated. Example: a. State the properties of wave b. Explain refraction and polarization c. Differentiate between angle of incidence and angle of reflection
Conclusion:	The teacher presents the summary of the lesson while students jot down in their books

WEEK FIVE

Week:	Five
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Light and sound waves
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. List different sources of light waves 2. Determine the angle of reflection for a given angle of incidence 3. Draw ray diagrams to show the formation of images by plane and curved mirrors 4. State the Charecteristic of sound wave 5. Explain forced vibration and how it is used to amplify a sound
Previous knowledge:	Students have learnt about the Properties of waves.
Instructional materials:	CD, Computer
Introduction:	Visualization, Grouping and Responsibilities of Members: The teacher introduces the lesson by presenting a short film containing lightening, thunderstorm, images in mirror and asking students some questions based on their previous knowledge and the visualization. Example: a. State the properties of wave b. Explain refraction and polarization c. Differentiate between angle of incidence and angle of reflection d. What make lightening in the presentation/ e. What is its source?
Presentation:	Introduction/Presentation Of Lesson Objectives
Step 1:	Computer Presentation + Group Tasks on: 1. Sources of light: a. Natural: sun and stars b. Artificial: candle, electric torch, lamp, arc light, incandescent
Step 2:	2. Determination of angle of incidence using: • Eclipse formation • Ray box • Shadows • Pinhole camera
Step 3:	3. Drawing of ray diagrams to show the formation of images by plane and curved mirrors

Step 4: Discussion And Observation Based On The Media Presentation:

Charecteristic of sound wave:

- Pitch
- Loudness and intensity
- Quality or tone

Forced vibration and how it is used to amplify a sound:

Force vibrations are those vibrations that result from an external periodic force acting on a system and setting system vibrating at the same frequency as the external periodic force.

Evaluation: Questions and Answer Session

The teacher asks students to narrate an experience they learn while viewing computer programme light and sound waves. The lesson will then be evaluated by asking students some questions based on the lesson treated.

Example:

- List different sources of light waves
- Draw ray diagrams to show the formation of images by plane and curved mirrors
- State the Characteristic of sound wave

Conclusion: The teacher presents the summary of the lesson while students jot down in their books.

WEEK SIX

Week:	Six
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Simple calculations on waves
Behavioral: objectives:	By the end of the lesson, students should be able to: • State some formulars of waves • Applly the formulars in solving some mathematical problems on waves
Previous: knowledge:	Students have learnt about the light and sound waves
Instructional materials:	CD, Computer
Introduction:	Visualization, Grouping and Responsibilities of Members: The lesson will be introduced by presenting films containing mathematical formulae and how they can be applied
Presentation:	Introduction/Presentation Of Lesson Objectives
Step 1:	Computer/Video Presentation + Group Tasks on Some useful formulars on waves Example: Progressive wave equation: $Y = A\sin\frac{2\pi}{\lambda}(x - vt)$ Velocity, frequency relation: $v = f\lambda$ etc
Step 2:	Discussion And Observation Based On The Media Presentation Example: Some mathematical problem on wave: Example 1: A plane progressive wave is represented by the equation y= Asin (200πt-0.5x)what is the frequency of the wave? Solution: $y = A\sin\left(\frac{2\pi x}{\lambda} - 2\pi ft\right)$ Comparing the above with the given equation, $y = 2\sin(2000\pi t - 0.5x)$ we have that: $2\pi ft = 2000\pi t$ Or $2ft = 2000t$ $f = 1000Hz$

Students' activity:

Example 2:

a radio station broadcasts at frequency of 300 kHz. If the speed of the wave is 3 x 10^8ms-1, calculate the period and wave length of the wave.

Evaluation:

solution

Period, T = $\frac{1}{Frequency} = \frac{1}{300\ x\ 10^3}$

T = $\frac{1}{300\ x\ 10^5}$ = 3.3 x 10^{-6}sec

Wavelength, λ = $\frac{v}{T} = \frac{300\ x\ 10^3}{300\ x\ 10^5}$ = 100m = 1km

Example 3

the freequency of vibrating a source is 450Hz and the velocity of the sound it produces in air is 330ms^{-1} find how far the soundtravels when the source completes 50 vibrations.

Solution time for 50 oscillations is given by

t = $\frac{1}{450}$ x 50 = $\frac{1}{9}$ sec

s = vt = 330 x $\frac{1}{9}$ = 36.67m

etc

Conclusion:

The students should narrate an experience they learn while viewing computer programme on mathematical problem on wave. The lesson will be evaluated by asking students some questions based on the lesson treated.

Example:

1. State some prograssive wave equation
2. a radio station broadcasts at frequency of 800 kHz. If the speed of the wave is 3 x 10^8 ms-1, calculate the period and wave length of the wave.

The lesson will be concluded by presenting the summary of the lesson while students jot down in their books.

APPENDIX F

LESSON PLAN FOR EXPERIMENTAL GROUP II
(LABORATORY FACILITIES ENRICHED WITH LECTURE METHOD)

WEEK ONE

Week:	One
Class:	SS II
Sex:	Mixed
Average age:	17 years
Subject:	Physics
Topic:	Concept of Wave
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. Define the terms wave. 2. State an example of waves
Previous: knowledge:	Students are aware of some activities occurring in the environment such as mirage, storm, druming etc.
Introduction:	Grouping And Responsibilities Of Members: The teacher present to the class a ripple tank, strings, pipes inflated with air, water in basin and asks students to observe the nature of motions in the three instruments and then explain that such movement or structure is called wave.The students were urged to obey the regulations of the laboratory.
Presentation:	The lesson will be presented based on the following steps:
Step 1:	The objectives of the lesson will be discussed with students.
Step 2:	Practical Using Laboratory Objectives: students to identify the facilities presented in.
Step 3:	Discussion And Observations Based On The Tasks
Step 4:	The class will discussed on the facilities for wave concepts and defines the concept of a waves. Example: 1. Wave is a disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium Examples of waves. Terminologies associated with wave concepts • amplitude • period • wave length • wave velocity .
Step 5: Evaluation:	Questions And Answer Session: The teacher asks students to narrate an experience they learn while viewing . The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: What is wave? What are the examples of wave? List down the types of waves.

Conclusion: The lesson was concluded by presenting the summary of the lesson while students jot down in their books and students were asked to solve the problems in exercise (B), questions 1 to 15.

WEEK TWO

Week:	Two
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Types of Wave
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. State the types ofwaves. 2. Explain each types ofwave 3. State examples of each wave type 4. Define wave motion
Previous: knowledge:	Students have learnt about the definition of wave concept.
Instructional materials:	Sonometer box Stroboscope Sonar (echo sounding devices)
Introduction:	The teacher present to the class a ripple tank, and pipes inflated with air, water in basin and asks students to observe the nature of passage of materials within each. The teacher then asks students to distinguish between the materials that requires medium in passing out of water and those that did not. The teacher proceeds by explaining to students that the passage of such water is term as propagation. Therefore there are some types of waves that requires medium in their propagation and there are those which do not. The students were urged to obey the regulations of the laboratory.
Presentation:	The lesson will be presented based on the following steps:
Step 1:	Presentation of the objectives of the lesson.
Step 2:	The class will be presented with laboratory facilities to identify and discuss among group members on the types of waves. Example: Transverse wave Longutudinal waves. Electromagnetic waves Mechanical waves e.tc
Step 3:	Group Discussion and Explanation of waves types Example: Electromagnetic waves is a type of wave that do not required a material medium for their propogation Mechanical waves is a type of wave that required a material medium for their propogation Examples of wave types Electromagnetic wave: light waves, radio waves, x-rays and gamma rays. Mechanical waves: water waves, sound waves, waves on a rope or string

Step 4:	Wave motion process involve in the transfering of disturbance which travels through a medium transferring energy fromone point to another without any transfer of particles of the medium The teacher asks students to narrate an experience they learn while interacting with laboratory facilities to differentiate wave types.
Evaluation: Conclusion:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: - What are the types of wave? What are the examples of mechanical wave? What is wave motion? The teacher presents the summary of the lesson while students jot down in their books.

WEEK THREE

Week: THREE
Class: SS II
Sex: Mixed
Average age: 17
Subject: Physics
Topic: Terminologies associated with wave concept
Behavioral objectives: By the end of the lesson, students should be able to:

1. Explain terminologies associated with wave concept:
    a. Cycle
    b. Frequency
    c. Wave length
    d. Period
    e. State the relationships between frequency, wavelength and velocity

Previous knowledge: Students have learnt about the types of wave.

Instructional materials: Laboratory Facilities for teaching wave concepts.

Introduction: The class will be presented with, strings, pipes inflated with air, watch and ripple tank and asks students to observe the demonstration by the teacher. The teacher explains to the students that the demonstration is about some terminologies used in explaining wave concept and this is the focus of our lesson. The students were urged to obey the regulations of the laboratory.

Presentation: The lesson will be presented based on the following steps:

Step 1: Presentation of objectives of the lesson.

Step 2: The teacher presented the laboratory facilities for teaching wave concepts and grouped students to identify the facilities and discussed on terminologies associated with wave concept.
Example:

a. Amplitude
b. Cycle
c. Frequency
d. Wave length
e. Period

Step 3: Discussion and explanation of terminologies associated with wave concept
Example:

1. Amplitude is the maximum displacement of a particle from its rest position
2. The time taken by a wave particle to make one complete oscillation is period e.tc

Step 4: Relationships between frequency, wavelength and velocity.

Velocity = frequency x wave length.

Evaluation:

$$V = \frac{\text{distance travelled by wave}}{corresponding\ time\ taken}$$

The students will be asks to narrate an experience they learn while using laboratory facilities to relate terminologies of waves.

Example:

- Explain the following terms:
  a. Cycle
  b. Frequency
  c. Wave length
  d. Period

  What is the mathematical relationship between frequency, wavelength and velocity?

Conclusion:

The teacher presents the summary of the lesson while students jot down in their books.

WEEK FOUR

Week:	FOUR
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Properties of waves
Behavioral: objectives:	By the end of the lesson, students should be able to: a. State the properties of wave b. Explain refraction and polarization c. Differentiate between angle of incidence and angle of reflection
Previous: knowledge:	Students have learnt about the terminologies of wave concept.
Instructional materials:	Laboratory Facilities for teaching wave concepts.
Introduction:	The lesson will be introduced by presenting to the class a concave and convex mirror, water in basin, ripple tank, strings, pipes inflated with air, compass, and torch light and demonstrate to the class some images produced when torch light is used on either concave, convex mirror or in water. The teacher allows students to narrate their experience based on their observations and interact by introducing the concept of refraction and polarization. The students were urged to obey the regulations of the laboratory.
Presentation:	The lesson will be presented based on the following steps:
Step 1:	Presentation of objectives of the lesson.
Step 2:	The teacher presents Laboratory Facilities for teaching wave concepts to each group and illustrates the Properties of wave. Example: a. Refraction b. Reflection c. Interference d. Diffraction e. Polarization
Step 3:	Explanation of the Properties of wave. Example: Refraction is the change in speed and direction of the waves as they cross the boundary pass from the medium etc
Step 4:	Differences between Angle of incidence and angle of reflection angle of incidence is the angle which the direction motion of the plane wavefront makes with the normal to the metal surface. Angle of reflection is the angle between the direction of motion of the reflected wavefront and normal OP to the plane surface. etc

Evaluation: The teacher evaluates the lesson by asking students some questions based on the lesson treated.

Example:

a. State the properties of wave
b. Explain refraction and polarization
c. Differentiate between angle of incidence and angle of reflection

Conclusion: The teacher presents the summary of the lesson while students jot down in their books.

WEEK FIVE

Week: Five
Class: SS II
Sex: Mixed
Average age: 17
Subject: Physics
Topic: Light and sound waves
Behavioral objectives: By the end of the lesson, students should be able to:

a. List different sources of light waves
b. Determine the angle of reflection for a given angle of incidence
c. Draw ray diagrams to show the formation of images by plane and curved mirrors
d. State the Charecteristic of sound wave
e. Explain forced vibration and how it is used to amplify a sound

Previous knowledge: Students have learnt about Properties of waves.

Instructional materials: Laboratory Facilities for teaching wave concepts.

Introduction: The teacher present to the class a compass, torch light, drum, mirror and demonstrate some exercise on production of angle, shadows and sound production and discuss with students on the demonstration. The students were urged to obey the regulations of the laboratory.

Presentation:

Step 1:

The teacher presents the lesson based on the following steps:
Sources of light:

a. Natural: sun and stars
b. Artificial: candle, electric torch, lamp, arc light, incandescent

Step 2:

Determination of angle of incidence using:

- Eclipse formation
- Ray box
- Shadows

Step 3:

- Pinhole camera

Drawing of ray diagrams to show the formation of images by plane and curved mirrors

Step 4:

Charecteristics of sound wave:

- Pitch
- Loudness and intensity
- Quality or tone

Step 5: Forced vibration and how it is used to amplify a sound:

Force vibrations are those vibrations that result from an external periodic force acting on a system and setting system vibrating at the same frequency as the external periodic force.

Evaluation: The teacher evaluates the lesson by asking students some questions based on the lesson treated.
Example:

- List different sources of light waves
- Draw ray diagrams to show the formation of images by plane and curved mirrors
- State the Characteristic of sound wave

Conclusion

The teacher presents the summary of the lesson while students jot down in their books.

WEEK SIX

Week:	Six
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Simple calculations on waves
Behavioral: objectives:	By the end of the lesson, students should be able to: • State some formulars of waves • Applly the formulars in solving some mathematical problems on waves
Previous knowledge:	Students have learnt about the light and sound waves
Instructional materials:	Laboratory Facilities for teaching wave concepts.
Introduction:	The teacher present to the class a calculator, compass bearing and some mathematical formulas and perform some calculations based on their previous knowledge related to application of formulas in calculating angles. The students were urged to obey the regulations of the laboratory.
Presentation:	
Step 1:	The teacher presents the lesson based on the following steps: The students will be grouped and presented with Laboratory Facilities for teaching wave concepts to illustrate some some useful formulae on waves Example: Progressive wave equation: $Y = A\sin\frac{2\pi}{\lambda}(x - vt)$
Step 2:	Velocity, frequency relation: $v = f\lambda$ etc Some mathematical problems on wave: Example 1: A plane progressive wave is represented by the equation y= Asin (200Meanr-0.5x)what is the frequency of the wave? Solution: $y = A\sin\left(\frac{2\pi x}{\lambda} - 2\pi ft\right)$ Comparing the above with the given equation, $y = 2\sin(2000\pi t - 0.5x)$ we have that: $2\pi ft = 2000\pi t$ Or $2ft = 2000t$ $f = 1000Hz$

Example 2:

a radio station broadcasts at frequency of 300 kHz. If the speed of the wave is 3 x 10^8ms-1, calculate the period and wave length of the wave.

Solution Period, T = $\frac{1}{Frequency} = \frac{1}{300\ x\ 10^3}$

T = $\frac{1}{300\ x\ 10^5}$ = 3.3 x 10^{-6}sec

Wavelength, $\lambda = \frac{v}{T} = \frac{300\ x\ 10^3}{300\ x\ 10^5}$ = 100m = 1km

Example 3

the freequency of vibrating a source is 450Hz and the velocity of the sound it produces in air is 330ms^{-1} find how far the soundtravels when the source completes 50 vibrations.

Solution

t = $\frac{1}{450}$ x 50 = $\frac{1}{9}$ sec

s = vt = 330 x $\frac{1}{9}$ = 36.67m

Evaluation:

The lesson will be evaluated by asking students some questions based on the lesson treated.

Example:

a. State some prograssive wave equation
b. a radio station broadcasts at frequency of 800 kHz. If the speed of the wave is 3 x 10^8 ms-1, calculate the period and wave length of the wave.

Conclusion:

Presentation of the summary of the lesson while students jot `down in their books.

APPENDIX G
LESSON PLAN FOR CONTROL GROUP
(LECTURE METHOD)

WEEK ONE

Week:	One
Class:	SS II
Sex:	Mixed
Average age:	17 years
Subject:	Physics
Topic:	Wave
Previous knowledge:	Students are aware of some changes that naturally occurred in the environment such as season, day, night etc.
Instructional materials:	Text books
Introduction:	The teacher introduces the lesson by asking students some questions based on their previous knowledge. Example What happen if you touch the part of drum while some one is beating it? What do you observe when water is moving in the pond or dam? E.tc.
Presentation:	The teacher present his lesson based on the following steps:
Step 1:	The teacher explains to the students the objectives of the lesson.
Step 2:	The teacher distributes text books materials to students and discuss on concept of wave Example: 1. Wave is a disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium?
Step 3:	Examples of waves.
Step 4:	Terminologies associated with describing wave concepts • amplitude • period • wave length • wave velocity .
Students' activity:	The teacher asks students to narrate an experience they learn during lesson.
Evaluation:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: - What is wave? What are the examples of wave? List three terms associated with wave concept.
Conclusion:	The teacher presents the summary of the lesson while students jot down in their books.

WEEK TWO

Week:	Two
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Types of Wave
Behavioral: objectives:	By the end of the lesson, students should be able to: 1. State the types ofwaves. 2. Explain each types ofwave 3. State examples of each wave type 4. Define wave motion
Previous: knowledge:	Students have learnt about the definition of wave concept.
Instructional materials:	Text book
Introduction:	The teacher introduces the lesson by asking students some questionsbased on their previous knowledge. Example What is wave? What are the examples of wave? State the terms associated with wave concept.
Presentation:	The teacher present his lesson based on the following steps:
Step 1:	The teacher explainsto the students the objectives of the lesson.
Step 2:	The teacher distributes text books materials to students and discuss on waves types. Example: Transverse wave Longutudinal waves. Electromagnetic waves Mechanical waves e.tc
Step 3:	Explanation of waves types Example: Electromagnetic waves is a type of wave that do not required a material medium for their propogation Mechanical waves is a type of wave that required a material medium for their propogation
Step 4:	Examples of wave types Electromagnetic wave: light waves, radio waves, x-rays and gamma rays. Mechanical waves: water waves, sound waves, waves on a rope or string

Step 5:	Wave motion process involve in the transfering ofdisturbance which travels through a medium transferring energy fromone point to another without any transfer of particles of the medium
Students' activity:	The teacher asks students to narrate an experience they learn while lesson on wave types.
Evaluation:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: What are the types of wave? What are the examples of mechanical wave? What is wave motion?
Conclusion:	The teacher presents the summary of the lesson while students jot down in their books.

WEEK THREE

Week: THREE
Class: SS II
Sex: Mixed
Average age: 17
Subject: Physics
Topic: Terminologies associated with wave concept
Behavioral objectives: By the end of the lesson, students should be able to:

1. Explain terminologies associated with wave concept:
   a. Cycle
   b. Frequency
   c. Wave length
   d. Period
2. State the relationships between frequency, wavelength and velocity

Previous knowledge: Types of wave.
Instructional materials: Text books
Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.
Example:
What are the types of wave?
What are the examples of mechanical wave?
What is wave motion?

Presentation: The teacher present his lesson based on the following steps:
Step 1: The teacher explains to the students the objectives of the lesson.
Step 2: Explanation of terminologies associated with wave concept

Example:

a. Amplitude
b. Cycle
c. Frequency
d. Wave length
e. Period

Step 3: Example:

1. Amplitude is the maximum displacement of a particle from its rest position
2. The time taken by a wave particle to make one complete oscillation is period e.tc

Step 4: Relationships between frequency, wavelength and velocity.
Velocity = frequency x wave length
V = distance travelled by wave/ corresponding time taken

Students' activity:	The teacher distributes text books materials to students and asks them to relate terminologies of waves.
Evaluation:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: Explain the following terms: a. Cycle b. Frequency c. Wave length d. Period What is the mathematical relationship between frequency, wavelength and velocity?
Conclusion:	The teacher presents the summary of the lesson while students jot down in their books.

WEEK FOUR

Week: FOUR
Class: SS II
Sex: Mixed
Average age: 17
Subject: Physics
Topic: Properties of waves
Behavioral: By the end of the lesson, students should be able to:
objectives:

a. State the properties of wave
b. Explain refrection andpolarization
c. Differentiate between angle of incidence and angle of reflection

Previous knowledge: Terminologies of wave concept.
Instructional materials: Text books
Introduction: The teacher introduces the lesson by asking students some questions based on their previous knowledge.

Examples:

Explain the following terms:

d. Cycle
e. Frequency
f. Wave length
g. Period

What is the mathematical relationship between frequency, wavelength and velocity?

Presentation: The teacher present his lesson based on the following steps:
Step 1: The teacher explains to the students the objectives of the lesson.
The teacher distributes text books materials to students and itemised the Properties of wave.
Example:

a. Refraction
b. Reflection
c. Interference
d. Diffraction
e. Polarization

Step 2: Explanation of the Properties of wave.

Example: Refraction is the change in speed and direction of the waves as they cross the boundary pass from the medium etc
Differences between Angle of incidence and angle of reflection
angle of incidence is the angle which the direction motion of the plane wavefront makes with the normal to the metal surface.
Angle of reflection is the angle between the direction of motion of the reflected wavefront and normal OP to the plane surface.
etc

Students' activity:	The teacher asks students to narrate an experience they learn during lesson.
Evaluation:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: State the properties of wave Explain refrection andpolarization
Conclusion:	Differentiate between angle of incidence and angle of reflection The teacher presents the summary of the lesson while students jot down in their books.

WEEK FIVE

Week:	Five
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Light and sound waves
Behavioral: objectives:	By the end of the lesson, students should be able to: a. List different sources of light waves b. Determine the angle of reflection for a given angle of incidence c. Draw ray diagrams to show the formation of images by plane and curved mirrors d. State the Charecteristic of sound wave e. Explain forced vibration and how it is used to amplify a sound
Previous knowledge:	Terminologies of wave concept.
Instructional materials:	Text book
Introduction:	The teacher introduces the lesson by asking students some questions based on their previous knowledge. Example: a. State the properties of wave b. Explain refrection and polarization c. Differentiate between angle of incidence and angle of reflection
Presentation:	The teacher presents the lesson based on the following steps:
Step 1:	Sources of light: 1. Natural: sun and stars 2. Artificial: candle, electric torch, lamp, arc light, incandescent
Step 2:	Determination of angle of incidence using: • Eclipse formation • Ray box • Shadows • Pinhole camera
Step 3:	Drawing of ray diagrams to show the formation of images by plane and curved mirrors
Step 4:	Charecteristic of sound wave: • Pitch • Loudness and intensity • Quality or tone

Step 5:	Forced vibration and how it is used to amplify a sound: Force vibrations are those vibrations that result from an external periodic force acting on a system and setting system vibrating at the same frequency as the external periodic force.
Students' activity:	The teacher ask students to narrate their experince on light charecteristic
Evaluation:	The teacher evaluates the lesson by asking students some questions based on the lesson treated. Example: • List different sources of light waves • Draw ray diagrams to show the formation of images by plane and curved mirrors • State the Charecteristic of sound wave
Conclusion:	The teacher presents the summary of the lesson while students jot down in their books.

WEEK SIX

Week:	Six
Class:	SS II
Sex:	Mixed
Average age:	17
Subject:	Physics
Topic:	Simple calculations on waves
Behavioral: objectives:	By the end of the lesson, students should be able to: • State some formulars of waves • Applly the formulars in solving some mathematical problems on waves
Previous knowledge:	Light and sound waves
Instructional materials:	Physics text book
Introduction:	The teacher introduces the lesson by asking students some questions based on their previous knowledge. Example: • List different sources of light waves • Draw ray diagrams to show the formation of images by plane and curved mirrors • State the Charecteristic of sound wave
Presentation:	The teacher presents the lesson based on the following steps:
Step 1:	Some useful formulars on waves Example: Wave: $Y = A\sin\frac{2\pi}{\lambda}(x - vt)$ Velocity, frequency relation: $v = f\lambda$ etc Some mathematical problem on wave:
Step 2:	Example 1: A plane progressive wave is represented by the equation y=sin (200πt-0.5x)what is the frequency of the wave? Solution: $y = A\sin\left(\frac{2\pi x}{\lambda} - 2\pi ft\right)$ Comparing the above with the given equation, $y = 2\sin(2000\pi t - 0.5x)$ we have that: $2\pi ft = 200\pi t$ Or $2ft = 2000t$ $f = 1000Hz$

Example 2

a radio station broadcasts at frequency of 300 kHz. If the speed of the wave is 3 x 10^8ms-1, calculate the period and wave length of the wave.

solution

Period, T = $\frac{1}{Frequency} = \frac{1}{300\ x\ 10^3}$

T = $\frac{1}{300\ x\ 10^5}$ = 3.3 x 10^{-6}sec

Wavelength, $\lambda = \frac{v}{T} = \frac{300\ x\ 10^3}{300\ x\ 10^5}$ = 100m = 1km

Example 3

the freequency of vibrating a source is 450Hz and the velocity of the sound it produces in air is 330ms^{-1} find how far the soundtravels when the source completes 50 vibrations.

Solution

time for 50 oscillations is given by

t = $\frac{1}{450}$ x 50 = $\frac{1}{9}$ sec

s = vt = 330 x $\frac{1}{9}$ = 36.67m

etc

Students' activity: The teacher asks students to narrate an experience they learn while during lesson on mathematical problem on wave.

Evaluation: The teacher evaluates the lesson by asking students some questions based on the lesson treated.

Example:

1. State some prograssive wave equation
2. a radio station broadcasts at frequency of 800 kHz. If the speed of the wave is 3 x 10^8 ms-1, calculate the period and wave length of the wave.

Conclusion: The teacher presents the summary of the lesson while students jot down in their books.