EFFECTS OF IMPROVISED INSTRUCTIONAL MATERIAL ON PERFORMANCE AND RETENTION OF PROPERTIES OF WAVES AMONG SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN SULEJA METROPOLIS.

BY

Fadipe, Bayo Michael
M.TECH/SSSE 2008/2004

DEPARTMENT OF SCIENCE EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

2012

ABSTRACT

The study investigated the effect of the use of improvised instructional materials, on performance and retention of properties of waves among senior secondary school physics students. Pretest, post- test experimental group design was used for the research study. The study comprised of senior secondary schools in Suleja Local Government area of Niger state. Samples of One hundred and twenty (120) students were selected through systematic sampling technique. The instrument used for collecting data was adopted from the National Examination Council (NECO) past theory question papers from 1988-2010. Having been internally validated, the items were subjected to another validation by team of experts, for content and criterion related validity. Test Re-test method with an interval of two weeks was used to obtain data for reliability co-efficient, R=0.74 was obtained. Four (4) null hypotheses were formulated, three were not rejected and one was rejected. The 12.0 Version of Statistical Package for Social Sciences (SPSS) was used to analyze the data obtained. The findings of the research work revealed that, the use of improvised instructional materials influences student's active interest and involvement in the learning process and enhances learning and retention abilities. It was also discovered that improvisation is gender friendly. It was recommended that the government should organize seminars, workshops symposium and training on the use of improvised instrumental materials to enhance learning achievement and retention among students.

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1.0 INTRODUCTION

1.1 Background of the Study

The Federal Government of Nigeria is actively involved in providing quality education to the citizens of the country. This of course, is in realization that no country can develop in any dimension unless quality education is provided to her citizens. The Federal Government of Nigeria has adopted education as an instrument per excellence for effecting national development. As such, the Federal Government assumed the responsibility for improving the standard, at all levels of education by encouraging the use of quality educational techniques. These quality and modern educational techniques have therefore been incorporated in all types of education, formal, informal and non-formal education.

Science is the foundation upon which the bulk of the present day technological breakthrough is built. Nowadays, nations all over the world including Nigeria are striving hard to develop technologically and scientifically, since the world is turning scientific and all proper functioning of lives depend greatly on science. According to philosophers of science; Science can be defined as a body of knowledge which encompasses mathematics and formal logic. Owolabi (2004) defined science as an integral part of human society. Its impact is felt in every sphere of human life so much that it is intricately linked with nation's development. Science as a field of study has done a lot for mankind. For instance, life has been made a lot easier for man as a result of the advancements in science. Through science man has been able to better understand his environment and this enabled him to manipulate the conditions of his environment to suit his own benefit, science has also made it possible for man to acquire his desired need easily. It has reduced human needs to the barest minimum. Ogunleye (2000) observed that science is a dynamic human activity centered with understanding the workings of our world. This understanding helps man to

know more about the universe. Without, the applications of science, it would have been impossible for man to explore the other planets of the universe. Also, the awareness of the existence, of other planets would not have been realized without science.

Science comprises the basic disciplines such as Physics, Chemistry, Mathematics and Biology. Many investigations have shown that students in secondary schools are not very much interested in sciences (Esiobu 2005: Okonkwo 2000). Besides, Physics as one of the science subjects has remained one of the most difficult subjects in the school curriculum. A study by Owolabi (2004) revealed that the performance of Nigerian students in Ordinary level Physics was generally poor. This was attributed by the author to the many factors linked to teaching strategy which was considered as an important factor. Over the years it was discovered that there are factors responsible for student's general poor performance in science, technology and mathematics. These are:

- poor laboratory facilities,
- Inability of the Physics teachers to put across ideas clearly to students.
- Inadequate number of learning facilities in schools as against consistent increase in the number of students.

Physics as a science subject is activity oriented and the suggested method for teaching it which is guided discovery method is resource base. This suggests that, the mastery of Physics concept cannot be fully achieved without the use of instructionally learning materials. The teaching of Physics without learning materials will certainly result to poor performance in the course. Franzer (1992) stressed that, a professionally qualified science teacher no matter how well trained would be unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate his /her competence into reality.

Bassey (2002) opined that science is resource intensive. Furthermore, in a period of economic recessions, it will be very difficult to adequately find some of the electronic gadgets and equipments for Physics in schools. A situation that is further compounded by

the galloping inflation in the country and often un-relatedness of some of the imported sophisticated materials and equipments; hence, the need to produce materials locally.

Researchers, such as Ogunleye (2000), Okonkwo (2000) Mkpanang (2005) and Obioha (2006) reported that, there were inadequate resources for the teaching of science subjects in secondary schools in Nigeria. They further stated that, where there were still resources at all, they are not usually in good conditions, while the few that were in good conditions were not enough to go round those who needed them. Hence, there is need for improvisation.

Omosewa (2008) and Akinsola (2000), considered the human factors as the teacher's professional commitment, creativity, mechanical skills, initiative and resourcefulness. They found that many of Nigerian Science teachers were aware of possibility of improvisation, but many exhibited poor attitudes towards improvisation. They also noted that, very few teacher practice improvisation while majority depends on imported equipments and claim that, improvisation is time consuming and fund depleting. The authors also noted that students possessed little or no interest in improvisation.

Onasanya (2008), Adebimpe (1997) and Aguisiobo (1998), noted that improvisation demands adventure creativity, curiosity and perseverance on the part of the teacher. The author added that such skills are only realizable through well planned training programmed on improvisation. Akinyemi and Orukota (1995) noted that improvisation whether they cost less than standard manufactured ones or not, they cost money. He added, this money is usually not readily available to teacher. The objective of any educational process determines the contents, methods and materials needed for achieving such objectives. The materials used for enhancing instructional effectiveness are aspect of media employed for achieving the instructional objectives. Bassey (2002) describes instructional material, as a system component that may be used as parts of instructional

processes which are used to disseminate information, message and ideas on which make possible communication in the teaching – learning process.

1.2 Statement of the Problem

The study sought to investigate the Effect of Improvised Instructional Materials on Performance and Retention of properties of waves among senior secondary physics students in Suleja metropolis Niger state.

The poor performance of students in physics at the final Senior Secondary School Certificate Examination (SSCE) that is West Africa Examination Council (WAEC) as shown in the table below:

Year	Total Entry	Percentages pass in Physics.
2005	**344,411**	**41.50**
2006	**345,225**	**43.84**
2007	**427,390**	**58.05**
2008	**424,693**	**48.26**
2009	**429,174**	**43.56.**

TABLE 1.0: Percentage Scores of WAEC Result in Physics for 2005 - 2009

Source - WAEC Office Yaba Lagos.

From the table above it is discovered that, the student performance in physics dropped seriously from 2007-2009, and the over all performance is not encouraging, if not 2007 that had a performance percentage above 50, all other years reviewed showed a performance percentage bellowed 50. This is very poor for a nation like Nigeria that is tending towards self dependent in technological development.

In recent times, it is disturbing and calls for urgent attention. In an attempt to find the cause and proffer a solution to the poor performance of student in this examination, the

researcher embarked on the effect of the use of improvised instructional materials in teaching properties of waves in physics using Suleja metropolis as a case study.

More so, research has shown that there are no improvised instructional materials on the area under study. In schools where such materials are available, they are only in chart forms of diagrams, no concrete models. The researcher seeks to use concrete improvised instructional materials to bridge the gap between charts and diagrams.

The study further investigates influence on the instructional materials on genders.

1.3 General aim of the Study

The general aim of the study is:

To improvised concrete instructional materials on the properties of waves and to determine the effect of improvised materials on student's performance and retention in Suleja metropolis.

1.4 Purpose of the Study

The purpose of the study is to find out the effect of improvised instructional materials on learning performance and retention of properties of waves among senior secondary physics students. They include the following:

1. To find the effect of the use of improvised instructional materials on the learning performance in the experimental and control group.

2. To find the mean difference between the male and female students in the experimental and control group.

3. To investigate the influence of improvised instructional material on retention in the experimental and control group.

4. To investigate the influence of improvised instructional materials on retention among male and female students in the experimental group.

1.5 Research Questions

The following research questions were formulated:

1. What will be the mean difference between the experimental and the control group in the post test after treatment?
2. What will be the mean difference between the male and female students in the post test of the experimental group after treatment?
3. What will be the mean difference between the experimental and the control group be in delayed post test?
4. What will be the mean difference between the male and female students in the delayed post test in the experimental group?

1.6 Research Hypotheses.

Based on the statement of the problem the researcher came up with the following hypotheses.

HO_1: There is no significant difference between the mean performance scores of students taught physics with improvised instructional materials and those taught without them.

HO_2: There is no significant difference between the mean performance scores of male and female students in the experimental group taught physics with improvised instructional materials.

HO_3: There is no significant difference between the mean retention score of students taught physics with improvised instructional materials and those taught without them.

HO_4: There is no significant difference between the mean retention scores of male and female students in the experimental group taught physics with improvised instructional materials.

1.7 The Significance of the Study.

This thesis titled **Effect of Improvised Instructional Material on Performance and Retention of Properties of Waves Among Senior Secondary School Physics Students In Suleja Metropolis** is of great significance to the following groups of persons or organization.

To the teacher

The result of the study will help to improve the teaching and learning of Physics in our secondary schools.

Teachers will benefit from this study in that it will encourage them to be self reliance and skill minded in their profession.

It will further help teachers to know how the use of improvised material can affect gender.

To the student:

Student will find Physics more interesting and it will expose the use of improvised instructional materials in our schools.

The study will also help to discover the effect and the use of improvised instructional materials on our students.

To the Government.

The study will encourage the government to concentrate on the use of improvised instructional materials.

The result of the study can also be used by the government to channel appropriate resources towards the production of improvised instructional materials

The result of the study can also be used by government to carry out seminar of training teachers on the place of improvisation in the school sector.

To the Parents.

Parents with strong intention to promote learning in their wards will find the study relevant, as they can use the improvised instructional materials at home for teaching their wards.

Parents can also take advantage of the affordability and availability of the improvised instructional materials to elevate the academic performance of their wards at home.

Educational Administrators.

The educational administrators, such as principal, proprietor, headmasters, supervisors, e.t.c. will find the study rewarding if inculcated in the school system.

The information and result gotten from the study if accessed and harnessed will help administration to upgrade the academic performance of their wards.

Curriculum planners will find the result of the research of immense benefit, in that; it will help determine the impact of the already existing curriculum.

Non- Governmental Organizations

NGOs whose aim is to promote performance in education such as UNICEF will find the study rewarding as it will promote self reliance.

The result of the study can be use by NGOs to improve on their performance in the educational sector.

With the result of the study NGOs can take advantage of it to organize training and re-training for teachers.

NGOs can also use the study as a medium of mass-producing improvised instructional materials.

Researchers

Researchers in the educational sector will find the result of the study rewarding as it can be used for further research work.

Researchers can also use the study to go into other vital areas of improvisation to enhance the efficiency of the teaching profession.

The study will also make researchers to investigate on cost minimization as regards improvisation.

Conclusively, the result of the research is aimed to improving the quality of teachers and the quality of students in Physics.

1.8 Scope of the Study.

The geographical area covered by this study is the Suleja metropolis of Niger State Senior Secondary two (SSII) was used for the study hence the subject matter content falls into SSII curriculum, the areas includes, waves, types of waves, properties of waves and simple calculations using waves formula and the study lasted for six weeks.

1.9 Basic Assumptions

1. That the school used for the study was a good representation of all the schools in Suleja Niger State considering the criteria, entrance examination and performance at final year examination of senior secondary schools.

2. That adequate precaution measures were being taken by the researcher during the study to guide against bias, but to ensure valid and reliable research work.

1.10 Operational Definition of Terms.

- **Instruction**: Defined as the deliberate arrangement of experience to help a learner achieve a desirable change in behaviour.

- **Instructional Materials**: Refers to devices or materials which present a body of information and largely self-supporting in the teaching/learning process.

- **Learning**: In general term for a relatively lasting change in behavior caused directly by experience.

- **Improvisation:** Entails the production of equipment using available local and cheaper resources and the use of such equipment for effective teaching.

- **Waves:** This is a disturbance which travels through a medium and transfers energy from one point to another without any permanent displacement of the medium itself.

- **Properties of Waves:** Waves have four major properties they are:

    1. **Reflection**: this is the change in the direction of the waves when they hit an obstacle as shown below

    2. **Refraction**: This occurs between two media when wave direction of propagation changes as it enters a different medium. When straight waves pass from deep to shallow waters, their wavelength becomes shorter. During this process, the frequency remains the same but the wavelength varies.
    3. **Diffraction**: This is a phenomenon whereby waves bend round obstacles. It is also the spreading of waves after passing through tiny opening, aperture, a hole or a slit. The smaller the width of the aperture, the smaller the wavelength. The greater will be the spreading of the waves. Similarly the bigger the width of the aperture the longer the wavelength, the smaller will be the spreading of the waves.

4. **Interference**: This occurs when two waves from a source cross each other's path. That is the interaction of two (coherent) waves which moves simultaneously through the same medium.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The literature was reviewed on the following areas:

- Conceptual framework
- Theoretical framework
- Related empirical studies

2.2 Conceptual Frame Work

2.2.1 Meaning of Instructional Materials

Instructional materials are usually described as concrete or physical object which provides sound or visual or both to the sense organs during teaching (Agina-Obu 2005). Instructional materials are in various classes such as

- Audio or aural instructional materials
- Visual or concrete instructional materials
- Audio/visual instructional materials

The audio or aural instructional materials are those instructional materials that appeals to the sense of hearing only like radio, audio tapes etc.

Visual or concrete instructional materials are those instructional materials that appeals to the sense of sight only, such as the chalk boards, chart, slide, film strip, graphs, figures e.t.c

Audio-visual instructional materials however appeals to both the sense of sight and hearing. Among these instructional materials the classroom teacher uses of the visual out numbered the combination of the audio and audio visuals.

Experience over the years has shown that teachers have been depending on excessive use of words to express or convey ideas or facts in the teaching – learning process. This

practice is termed the “chalk – talk” method. Today, advances in technology have made it possible to produce materials and devices that could be used to minimize the teachers talking and at the same time make the message clearer, more interesting and easier for the learners to assimilate. (Onasanya 2008). According to Soetan (2010) graphics includes:

- Charts
- Posters
- Sketches
- Cartoons
- Graphs and drawings.

Graphics communicate facts and ideas clearly through combination of drawings, words and pictures. The use of graphic in teaching creates definitiveness to the materials being studied. They help to visualize the whole concepts learned and their relationships with one another.

The role of graphic materials in visual communication is both unique and significant. Historically symbols, a basic part of graphic have made it possible for a whole range of written language used in the world today. The instructional value of graphical illustration lies generally in their capacity to attract attention and convey certain types of information in condensed form (Orasanya and Adegbija, (2007) Okpala (1998) stated that graphical illustration provide a common experience to a large group at a time. Okpala (1998) also summaries the values of graphics for instructional design as follow. They require no special machine for projection, the teacher is confident in manipulating the material, their improvisation encourage more creativity and diversification of teaching methods, they are very easy to preserve and they could be provided within minimum cost and maximum efficiency.

2.2.2. Meaning of Improvisation

Improvisation means the act of creating something in the absence of the ideal tools. According to Webster's dictionary (2004) improvisation is to provide, select or make substitute for something not available to use as the basis of free invention. Various authors have defined the concept improvisation in different ways. Ogunbiyi, Okebukola, Fafunwa (1990) defines it as the act of substituting for the real thing that is not available. Bajah (1991) takes it to be the use of substitute equipment where the real one is not available. Kamoru and Umeano (2006) further defined it as the act of using material obtainable from the local environment or designed by the teacher or with the help of local personnel to enhance instruction according to Ihiegbulem (2007), it is the act of substituting for the standard equipment or instructional material not available with the locally made equipment or instructional material from readily natural resources. National Teachers Institute in Omachi (2000) defines improvisation as the act of using alternative materials and resources due to lack of insufficient hand teaching aids to facilitate instruction. From these opinions improvisation entails the production of equipment using available local and cheaper resources and the use of such equipment for effective teaching.

Orasanya (2004) gave various kinds of models used in educational instruction namely:

- mental models
- theoretical models
- mathematical models
- diagrams
- concrete models etc

These types of model are of special pedagogic significance in science and technology instruction, due to the nature of knowledge and knowledge getting process in these

disciplines. Concrete models are material object which are likeness of natural or man-made structure or system and which are intended to high-light and explain or describe structures, functional process and relationship in the original. Concrete models are constructed in the effort to understand the behavior of the physical world and the causes of such behavior. (Onasanya and Adegbija 2007) summarized the role of concrete model as follows:

- Simplification of complex phenomenon
- Concretization of complex phenomenon
- Bridging of gaps in distance and time between phenomenon and classroom event.
- Enhancing of students ability to communicate in science

In addition, concrete models can help the retentive abilities of students in physics since, concrete model appeals to the sense of sight and sense of imagination. The model keeps the image in the student's mind. As a result retention is enhanced. More so, improvisation on most occasion has to do with the use of locally found materials within our immediate environment, these material are already familiar to the students and so it tends to boost the creative ability of the students.

In summary, improvisation will help build both students and teachers in the following areas.

- **Adventurous capacity:** with improvisation teachers will be adventurous and seek to make use of available resources to both acquire knowledge and drive home teaching, with such search the capacity and innovative ability of both students and teachers is built up.

- **Creativity:** Science in general is creative based, any scientist that lacks creative ability cannot impact on his/her generation or cannot contribute meaning fully to the development of educational system. Improvisation encourages creativity and it can help develop the creative ability of the students and the teacher, because it will require the teacher to work out things by himself

- **Skills development:** A creative mind ends up becoming skillful. Improvisation will develop the skills of the teacher and the students, because the students can also be encouraged to participate in the provision of the improvised materials.

- **Retentive ability:** Students tends to keep in memory those things they see with their eyes. Improvisation will help improve student's retentive ability as the materials used for improvisation are familiar, readily available and can be found around our immediate environment.

- **Bridge gender gap in physics:** improvisation can help bridge the gender gap in the study and knowledge of physics, research has shown that the female folks are always scared of subjects such as physics but if what is used (improvised) to teach the subject are common and locally made, it can boast the courage of the female folks in the learning of physics.

The term science can be used to refer to a product (a body of knowledge), a process (a way of conducting inquiry), and an enterprises (the institutionalized pursuit of knowledge of the material world) (STAN 2000) proceedings. The distinct trait of scientific knowledge is that, it provides material explanations for the behavior of the material world, that explanation in terms of the entities that make up the world and their properties. (Miller, 2004).

In view of the fact that subject matter of science is the material world, it seems natural, and rather obvious, that learning science will involve seeing, handling and manipulating real object and materials and teaching science will involve acts of showing as well as of telling (Balogun, 2001). Science is valued because of it's achievement in explaining phenomenon in elegant and flamboyant ways which are intellectually satisfying and which often facilitate the purposeful manipulation of objects materials and events (Nwoye 2002).

Science teaching-learning gains prominence on daily basis simply because of the consistent emphasis and science and technology due to its application in industrial development. This situation is not limited to the third world countries as even the developed countries are equally in the race. For instants in 200 the Australian government commissioned a research into science in schools (SIS) with the aim of developing an effective change strategy to suPp.ort schools to improve science teaching and learning (Tyler, 2004.).

The literature is reviewed under the following headlines

- Conceptual frame work
- Theoretical frame work
- Current literatures/Related empirical studies.

2.3.0. Theoretical Frame Work.

A physical law of nature is a scientific generalization based on a variety of sufficiently large number of empirical observation that are taken as fully verified (Wikipedia, 2006) weavers cited in Gbodi and Laleye (2006) "sees science as a universal snake oil to kill all disease".

Learning is commonly defined as a process that brings together cognitive, emotional and environmental influences and experiences for acquiring, enhancing or making changes in one's knowledge, skill, values and world views (Illeris 2004, Ormrod 1996). It is also taught of as the ways in which information is absorbed, processed and retained. Learning

theories are elaborate hypothesis that describes how exactly these procedures occur. Learning theories have two chief values according to Hill (2002). One is in providing us with vocabulary and conceptual framework for interpreting the examples of learning that we observed. The other is in suggesting where to look for solutions, but they do not direct our attention to these variables that are crucial in finding solutions. It is also thought of as the ways in which information is absorbed, processed and retained and being reinforced for current responses and behavior.

2.3.1. Cognitive Orientation – Cognitive theories of learning are concerned with processes which occur inside the brain and nervous system as a person learns. They share the perspective that people actively process information and learning takes place through the effort of the learner. Internal mental process includes inputting, organizing, storing, retrieving and finding relationships between information. Gestalt's learning theories emphasized perception, inside, and meaning as key element of learning. The individual was seen as a perceptual organism, which organizes, interprets and gave meaning to the event that impinged upon his consciousness. Making sense of events and phenomena was driving concept.

The learner makes sense of things by thinking about them. Improvisation, will no doubt affect the cognitive domain of a student learning ability as research has proved that retention is affected via improvisation.

2.3.2. Humanist Orientation

Humanistic theories shift the emphasis to the potential for individual growth in the learner. They bring the effective functioning of the human into the arena of learning. Freud's psychoanalytic approach to behavior was a powerful influence on the humanistic learning theories. Many of feuds concepts, such as the subconscious mind, anxiety, depression, defense mechanism, drives and transference found their way into the humanistic learning theories.

There are three main categories or philosophical frameworks under which learning theories fall.

- **Classical conditioning**

  This is a conditioning, where the behavior becomes a reflex response to stimulus as in the case of Pavlov's dogs, which can be directly related to the use of concrete material for achieving learning among students

- **Operant conditioning**

  This is conditioning where there is reinforcement of the behaviors by a reward or punishment. The theory of operant conditioning was developed by B.F Skinner and is known as radical behaviorism. The word "operant" refers to the way in which behavior operates on the environment.

  In summary, a behavior may result either in reinforcement, which increases the likelihood of the behavior recurring, or punishment, which decreases the likelihood of the behavior reoccurring. Behaviorists are particularly interested in measurable changes in behavior. Since behaviorist view the learning process as a change in behavior, educators arrange the environment to elicit desire responses through such devise as behavior objective, competency-base education and skill development and training. Cognitive theories grew out of Gestalt psychology developed in Germany in the early 1900s. This theory emphasizes the whole of human experience. The theory provided compelling demonstrations and described principles by which we organize our sensation into perceptions. Two keys assumptions underline this cognitive approach. First, that the memory system is an active organized processor of information. Secondly, that prior, knowledge places an important role in learning. Cognitivism considers how human memory works to promote learning. For example, the physiological processes of sorting and according information and event into short term memory and long-term memory are important to educators working under the cognitive theory. These, theories of learning place a role in influencing instructional design educators employing a cognitivist approach

to learning would view learning as internal mental process (including insight, information processing, memory, perception) where in order to developed learner capacity and skill to improve learning, the educator structures content of learning activities to focus on building intelligence and cognitive and meta-cognitive development.

- **Constructivism**

  Constructivism is a revolution in educational psychology, built on the work of Pieget and Bruner. Constructivism emphasizes the importance of active involvement of learners in constructing knowledge for themselves. Constructivism emphasizes top down processing begin with complex problem and teach basic skills while solving these problems.

  Constructivism explains why student do not learn deeply by listening to a teacher, or reading from a textbook. Learning sciences research is revealing the deeper underlying basis of how knowledge construction works. Constructivism views learner as a process in which the learner actively constructs or build new ideas or concepts based upon current and past knowledge or experience. Constructivism itself has many variations, such as, active learning discovery and knowledge building. Regardless of the variety, constructivism promotes a student's free exploration within a given frame work of structure which can be practically developed using instructional materials developed to suit such purpose.

2.3.3. Instructional Materials and Academic Achievement

There have been several studies on instructional materials and academic achievements. For instance, (Isola 2010). Conducted a research on the effects of instructional resources on student's performance in West Africa School Certificate Examination (WASCE) in Kwara state. He correlated materials resources with academic achievement of students in ten subjects. Data were covered from the subject teachers in relation to the resources employed in the teaching. The achievements of students in WASCE for the past five years were related to the resources available for teaching each of the subjects. He concluded that materials resources have a significant effect on student's achievement in each of the

subjects Olumatanmi (2000) considered five areas to be very crucial to understanding the values of instructional materials and summarizes them thus:

Learning theories have two chief values according to Hill (2002). One is in providing us with vocabulary and conceptual frame work, for interpreting the examples of learning that we observed. The other, is in suggesting where to look for solutions to practical problems. The theories do not give us solutions, but they do direct our attention to those variables that are crucial in finding solutions.

There are three main categories or philosophical frame works under which learning theories fall

- Behaviourism
- Cognitivism
- Constructivism

Behaviourism focuses only on the objectively observable aspects of learning. Cognitive theory looks beyond behaviour to explain brain based learning and constructivism views learning as a process in which the learner actively construct or builds new ideas or concepts. The above philosophical frame work correctly illustrate the use of instructional materials to achieve success in learning. Behaviourism which focuses on objectively observable aspects of learning can adequately be linked with the use of instructional materials (improvised) which is physical to the learner and so speaks to the sense of vision. On the other hand cognitive theory which looks beyond behaviour, also explained brain based learning. Instructional materials have been proven by many researchers to have positive result on the retentive ability of students, which correctly supports the cognitive domain. Constructiveness, which views learning as a process in which the learners actively construct or builds new ideas or concepts with improvised instructional aids. Definitely, new ideas are introduced into the students. As all the materials used are locally sourced.

John Watson (1878-1959) coined the term “behaviourism”, critical of Wundt’s emphasis on internal states. Behaviourism as a theory was primarily developed by B.F Skinner. It loosely encompasses the work of people like Edward Thorndike, Tolman and Hull etc. what characterizes this investigations are their underlying assumptions about the process of learning. In essence, three basic assumptions are held to be true. First learning is manifested by a change in behaviour. Second, the environment shapes behaviour. And thirdly, the principle of congruity (how close in time two events must be for a bond to be formed) and reinforcement (any means of increasing likelihood that an event will be separated are central to explaining the learning process for behaviourism. Learning is the acquisition of new behaviour through conditioning. There are two types of possible conditioning.

Classical conditioning: this is a conditioning where there is reinforcement of the behaviour by a reward or punishment. The theory of operant conditioning was developed by B.F Skinner and is known as radical behaviourism. The word “operant’ refers to the way

2.3.4 Effects on Learning

a**.** Helps learner to remember for longer time

b. Helps learner to read pictures or models with skill

c. Stimulate interest

d. Sharpens perception and ability of learners

e. Add enjoyment to learning

f. Permit learners to learn through personal experiences

g. Provides multi sensory avenue for learning

h. External interest of learners (New Internet)

i. Help learners to have critical approach to what they are learning.

2.3.5 Influence on Learning Habits

a. Can influence attitude

b. Can help change behavior/Attitude

c. Leads to experimentation and innovation

d. Promotes emotional feelings towards what is being learned

e. Promote better understanding of other people

f. Help to teach habit

2.3.6 Influence on the Learners

a**.** Help learners to develop planning ability

b. Stimulate a spirit of inquiry

c. Help learner to develop sense of judgment

d. Promote class co-operation amount learners

2.3.7. Effects on Classroom Environment

a**.** Help explain difficult concept

b. Encourage an informal approach to education

c. Subject becomes more real

d. Encourage learner's participation in activities

e. bring into class experiences that would otherwise not be available.

2.3.8. Effects on the Teacher

a. Help Teachers to reach slow Learners (in divided different difference)

b. Teacher can learn from instructional materials

c. Permit teachers to reach more learners

d. Help teachers to become more skill full

e. Help teachers to have better control of the class

f. Help teachers to organizes work better

Teaching materials not only arouse the learner's interest but, they also help focus the learner's attention on the lesson and so, shift educational activities from the teacher to the

learner. The foster understanding and help learners remember what they have learned. They also help in development of skills and attitudes in learners.

2.4.0 Related/Empirical Studies.

Dawody (2007) believes that instructional media provide concrete exposure and enable students integrate prior experience with new learning. He added that those experiences facilitate learning and acquisition, retention and usability of abstract symbols. Conclusively, they prove the teacher and learner with a variety of options to choose from, thereby enhancing efficiency of teaching and learning. Ayodele (2001) noted that, individual learns through different sense organs, some learn best through hearing, seeing and touching. He argued that learning will be more meaningful if all the senses are involved, such as the eyes, nose, mouth and tongue. Similarly, Nkpa (2001) noted that, the more the number of senses involved in instructional processes, the more efficient is the outcome. Students when actively involved in instruction tend to ask more questions and take initiatives. This is consistent with the findings of Adeleye (1982), in which Biology students involved in laboratory activities asked higher order questions and had higher cognitive achievement than those in the lecture method group. Nwachukwu and Nwosu (2007), STAN, in Nwachuckwu et al (2007) who assessed the effects of discovery and expository methods on achievement of low and high cognitive skills in biology observed that the discovery group performed better than the expository method group.

2.4.1 Improvisation

The individual with objects/materials in his environment. The individual can also learn through deliberate effort of an instructor or teacher. The instructor or teacher uses different methods and techniques to impart knowledge. In the course of teaching he uses instructional materials to help him achieve his goal or objectives. Some of the instructional materials may be readily available, but some may be difficult to come by due to one reason or the other, including lack of fund to purchase them (Nsofor, 1997)

However, improvisation of instructional materials simply means making (constructing) of substitutes from available materials when the real equipment is not available (NERDC, 1987)

Ango (1985), went further to explain that improvisation, rightly conceived means ; substituting something in place of another to serve a unique function, altering the shape, size or the look of a thing to serve a function other than that originally used for or intended to co-ordinating or formulating a totally new tool, instrument, materials, converting a tool, material or equipment into another form and devising an idea or material as means of solving a problem in hand.

It is therefore clear that the issue of improvisation is a matter of using both the head and the hand in constructing instructional material from available local materials. The problems created by lack of instructional material in our schools today can therefore be traced to lack of initiatives on the part of teachers. A resourceful teacher can always look for alternative ways of achieving his objectives by using self-made instructional materials.

In Ghana, for instance, the Ghana Elementary Science Scheme (GESS), directed by S. M. Adu –Ampona in Accra, aims at introducing comprehensive "science discovery ", by the use of local materials. According to Sagoe (1975), over 300 primary middle schools in Ghana have adopted the entire course.

However, in Nigeria, it is a common knowledge that science is not taught or properly taught in primary schools because teachers complain of lack of laboratories and science equipment. Madueke, (1997) questioned, for how long would this situation persist? An immediate solution would be a massive importation of science materials and equipment from developed countries. This option will not be easy because importation of science and technology equipment are very expensive, moreover, under the present economic depression, the Government might not be able to allocate sufficient fund for importation,

because of competing demands in other sectors of the economy. It is for these reasons that improvisation becomes inevitable.

The ability to improvise, especially for technical education in Nigerian technical college has been a major problem. If the problem persists, the high quality technical education expected at this level will be adversely affected. The consequences of a weak technical education at this level could be dangerous and disastrous for the present and future generation of this country. This is because according to Nwamadi (1998), expressed the fear that:

In a modern world where the scientific and technological enterprises have become integral part of the world 's culture, a nation which does not give priority considerations to the types of science and technology taught in its school, is risking the future of its youngsters.

Today, young people who are not properly equipped with the rudiment of contemporary science and technology will grow up only to discover that haphazard knowledge of science and technology are not sufficient to understand the sophisticated operations of advance science and technology".

In the regard, therefore, every effort should be made to make technical educational accessible to every Nigeria willing and with capabilities for the education. To solve the problem, however, the technical teacher requires some basic training on how to make some of the technical instructional materials using local resources. This is necessary because teaching is a specialized job. For one to be a good teacher in particular, a formal training is necessary. The training programme should lay emphasis on both academic and practical works. The practical training for instance, should feature prominently in the curriculum and production of instructional materials from local sources should be emphasized (Madueke, 1997). In line with this view, NERDC (!997), describes the problem of limited tools and equipment as a serious one in many African technical schools

and suggest that the teacher trainer should make certain that his student have acquired a wide variety of experiences in making and using inexpensive tools.

Madueke (1997) gives eleven (11) guideline on improvisation of instructional materials that the teacher should:

1. Be familiar with the content of the syllabus.
2. Know the appropriate instructional materials to use in teaching various topics in the course.
3. Be conversant with instructional materials or apparatus that are available and the one that could be improvised.
4. Decide which one should be bought and the one that could be improvised.
5. Whenever necessary, attempt to improvise even if an imported one is available. In such cases the two could be used and their suitability or effectiveness could be noted. Where the improvised item could not work or solve the problem the teacher and students should be able to explain why.
6. Explore the local environment such as the markets, craft centers blacksmith workshops, rivers, ponds, junk yards, hospitals, factories etcetera, to assess the availability of local materials for his work. He should prepare a list for easy reference.
7. Also consult books for guidance on how to carry out experiments and activities e.g. laboratory manual.
8. As much as possible involve students in the construction of improvised apparatus.
9. Encouraged individual initiative and students efforts commended.
10. In case the necessary skills in the construction of the required item are lacking the services of the local craft men may be used to get it done.
11. Make proper arrangement for storage of materials and adequate guideline gives for the use of finished products.

This is to minimize damage and wastage of materials. A discerning science teacher can easily discover that the immediate environment and neighborhood are often richly endowed with resources that could be of immense value in the construction of instructional materials. The new UNESCO source book (1976; 20) for science teaching identified the following as possible resources in rural areas.

(i) An abandoned farm field

(ii) A wooden or forest

(iii) A building under construction

(iv) A saw mill

(v) A vegetable and flower garden

(vi) An apiary for bee's observation.

(vii) A creek or pond

Other facilities include aquaria and terrarium, cages for animals, guardian, museum and host of other, many of the empty cans tins in the surrounding can serve different purposes if they are put into proper use. The students have been seeing a lot of these materials and have, in fact been playing with many of them. The problem has being how to convert the seemingly simple object into useful teaching materials.

The construction will require a lot of deep through reflection and foresight. And for the instructional materials to be meaningful they have to suit learner's mental development (Nsofor, 1997).

2.4.2 Retention Effect and Academic Achievement

Instructional materials otherwise known as teaching aid are some of the assistant material which teachers explore to make learning or teaching more effective and efficient lasting and enjoyable to pupils. Improvised materials that are used as both methods and instructional materials are effective for making students concentrate on, understanding, synthesizing and improving positive attitudes toward the subjects. Instructional materials make the topic clearer and more lasting by making topics that are abstract for students

more concrete. (Cepin etal 2004, Demirel, 2004) the use of visual improvised instructional materials is much more vital in the instruction of abstract concrete such as in physics lesson, this will in no small measure make the lesson more understanding and interesting.

Currently, it is glaring that instructional materials as found in the environment have been utilized in every field and technological devices, especially locally made ones have improved students knowledge. Some schools of thoughts believe that learning resulting from seeing is about 83%, Hearing 11% Smelling 3.5% Touching 1.5%, Tasting 1% (Daniel, 2004) others like Kucukamet 2001). Seeing 75% Hearing 13%, Smelling 6%, Touching 3% and Tasting 3%.

Meyer (2003) noted that experiment evident have shown that only oral explanation method doesn't work well. He argued that only if principles of how students learn are taken into consideration, the richness of improvised materials makes teaching more lasting, effective and efficient.

Cilenti and kinder (2006) in a fixed time learning is gained by reading 10% Hearing 20% Seeing 30%, Touch, Seeing and Hearing 50%,telling 70%, doing and telling 90% .(Simsek 2002, Damirel 2004, Yalin, 2006). Evidently this shows that, improvised materials used by the teacher are more effective on student's learning perception and synthesizing.

Kucukamet, 2001 and Damirel, 2004 shared the view that, organs dealing with learning are numerous and leading to better instruction and long. He concluded that the best mode of learning is by doing and see. The essence of educational research is to discover how to form a learning atmosphere, to provide and upper level learning with less expense and try in a starter's time (Yigit and Akdeiz, 2003). The provisions of educational and instructional materials having more visual content is desirable to students of the secondary schools age who lives visually and are in the bombardment of visual knowledge (Cephi et al,2004). The obsolete traditional method of teaching makes learning difficult and even for some concepts to be thought (Cephi et al 2004, London, 2005). Delialioglu and Yildrim (2008) investigated the effectiveness of the hybrid instruction in regard to student's

achievement, knowledge retention, attitude towards to the subject and cause satisfaction in comparison to traditional classroom instruction with model for learning and teaching activities (MLTA).

They concluded that, there is on significant different between the hybrid course and traditional course in student's achievement, knowledge retention, satisfaction and attitude Sager and Verhoven (2005) examined the longtime effects of a computer intervention for development of phological awareness in Dutch kindergartens. Following a pretest interim, test retention, test design, the effects in rhyming, phonemic segmentation, auditory blending, and grapheme knowledge were accessed. The result showed significant immediate effects on rhyming and grapheme knowledge. The well known science instruction is to provide student with learning concept and to make them aware of how to use this concept in their daily life (Cephni 2006) in one of the experiment carried out by London (2005) it was noted that the experimental group did better than the control group in retention($t= 6.86 > 0.05$). On the other hand the experimental group had a mean score of ($t = 6.36 > 0.05$), meaning that the experimental group did better than the control group on achievement. It also agrees the previous findings of Chu (2001).

2.4.3. Effects of Gender on Retention:

Researches conducted on the performance of male and female students shows that male and female students have equal tendencies to excel in science based subjects among them are findings of Gbodi, Hide and Ajiboye(2002). In Laleye (2004) Nwogu (2005) observed that there was no significant difference in the performance of male and female students exposed to graphic advanced organizer. Others of the view that there exist an appreciable gender difference in the intellectual capacity of male and female, for instance, Orisabiyi (2006) and Akanmu (2004) observes from studies that there is the tendency for female to be more fluent and precarious but scores lower marks than males in verbal reasoning, comprehension and logical comprehension of concepts on relationship. Research findings also revealed that male students achieved better in map interpretation

than their female counterpart in geography (Akanmu 2004). He added that there is gender difference in attitudes towards subjects; he noted that the poor achievement of girls in physical sciences might be due to their negative attitude towards the subject. Opera (2003) making reference to other findings on gender noted that in the society where gender stereotyping is very strong, the achievement aspirations and interest in girls are conditioned by what the society regards as male and female activity, career, behavior, right etc. some school of thought are of the view that some behaviors culturally acquired with the environment are the main factor that accounts for the difference. Based on the above, he suggested that strategies must be in place to accelerate gender equalities and neutrality in all fields of human endeavors as advocated by the Woman Rights Protection Agencies (WRAPA). In another development, (Okwu and Otuba 2007) noted that boys did better than girls in the physics essay test. "Gender explains 33.39% of the variance in the essay test scores of the students". (Pg. 88). He concluded that the finding is in disagreement with that of Lorchugh (2006) but in agreement with that of Ukwungwu (1996), in (Okwo 2007) the study conducted by Soyibo and Ezeiroma (1997) in Nwachukwu et al (2007) STAN reported that the male did significantly better than females but that twice as many females as males enroll for SSCE in biology. Similarly, it was noted that females in the experimental group did better than the males in both the experimental and control groups.

2.4.4. The Influence of Gender on Retention when Improvised Instructional Materials is Used

Many authorities and scholars have common grounds of opinions in respect to the gender influence in academic achievement(Obe, Ibitoye, Awoniyi and Balogun 1989, 1996, 2000, 2000) discovered that gender do not have any influence on academic achievement of students contrary to this, Jimo, Adebayo, and Mohammed, 1992, 1997 and 2000) believes that gender difference has influence on academic achievement. Ogie(2002) stated that boys and girls have equal potential and tendencies to excel in science, biochemistry,

microbiology among others. Forkuoh (2010) discovered that gender has no influence on the use of system approach for conducting chemistry practical. Gimba (2006) discovered that there was significant difference in the performance of girls and boys taught with mathematical instructional models. He observed that girls did better than boys in Mathematics Achievement Test (MAT). This is therefore in agreement with the findings of Benthan, (1964), Gambari (2004) Sobamowo (2006) who found that there was a significant difference in the performance of boys and girls taught physics and mathematics with computer. In a similar vain, it is contrary to the findings of Benthan (1964) who noted that boys perform better than girls in subject that requires calculation and science and that girls did better in art subjects and language than boys.

2.4.5 Need for the use of Improvisation of Instructional Materials to enhance the teaching of Physics.

Science has been regarded as the bedrock on which modern day technological breakthrough is built. Nowadays countries all over the world, especially the developing once like Nigeria, are striving hard to develop technologically and scientifically, since the world is turning scientific and all proper functioning of lives depend greatly on science. According to Ogunleye (2002) science is a dynamic human activity concerned with understanding the workings of our world. This understanding helps man to know more about the universe without the applications if science, it would be have been difficult for man to explore the other planets of the universe.

Science comprises the basic disciplines such as physics, Chemistry, Mathematics and Biology. Many investigations have shown that secondary school students are exhibiting dwindling interest in science (Esiobu 2005). Besides, physics as one of the subjects remains one of the most difficult subjects in the school curriculum according to the Nigerian Educational Research and Development Council (NERDC) (Isola 2010).

Studies have revealed that the performance of Nigerian students in ordinary level physics was generally and consistently poor over the years. Poor academic achievement in physics

could be attributed to many factors, among which teacher strategy itself was considered as an important factor. This implies that, the mastery of physics concept might not be fully achieved without the use of instructional materials. The teaching of physics without instructional materials may certainly result in poor academic achievement. Research has proved that a professionally qualified science teacher no matter how well trained would be unable to put his ideas into practice if the school settings lacks the equipment and materials necessary for him or her to translate his competence into reality.

Bassey (2002) opined that science is resource intensive and in a period of economic recession it may be very difficult to find some the electronic gadgets and equipment for the teaching of physics in schools adequately. A situation that is further compounded by the galloping inflation in the country. As a result, improvisation is the safest way out of the above mentioned challenging and glaring opposing conditions in order to enhance performance in physics.

More so, imported sophisticated materials and equipment are found expensive and irrelevant, have the need for improvisation. Researchers such as Obioha (2006) and Ogunleye (2002) reported that, there were inadequate resources for teaching science subjects in secondary schools in Nigeria. They further stated that the available ones are not usually in good conditions; there is need therefore for improvisation. Daramola (2008), however noted that, improvisational demands, adventure, creativity, curiosity and perseverance on the part of the teacher.

2.4.6. Factors Affecting Improvisation of Instructional Materials

Balogun (2002) identified two main constraints militating against the successful improvisation of science equipment. These are technical and the human factors respectively. While the technical factors relate to the question of degree of accuracy and precision that is possible with the improvised equipment, the human factors relate to the

teachers skill in developing the resources available while providing the appropriate learning experience to the learners.

Also, Maduabunmi (2003) reported lack of adequate professional training as a major problem militating against the effective use of improvised resources for science teaching, Oyediran Isola (2000) then stressed the need for a definite well planned training programme of improvisation for teachers. He suggested regular meaningful workshop on improvisation techniques for science teachers to improve and update their competence.

2.4.7. Improvisation of Physics Instructional Materials Using Available Resources.

Oguniyi describes improvisation as the act of substituting the real thing that is not available. Baja (2000) also sees it as the use of substitute equipment where the real one is not available. Summarily, it could be seen as the substitution for instructional material that is not available with locally made equipment or media from readily available natural resources Jaja (2002) believes that resource material utilization during practical lessons inculcating the learner the spirit of careful observation, manipulation skills reflective thinking creativity and understanding of natural phenomenon. Use of teaching resources fortuities what the student learn. This is in agreement with the findings of oguniyi, et al (2000) who held that, equipment made from things around us help to make concept and principle those not give the student impression that physics can only be learned with specialized equipment. Nwosu (2002) also believes that professional teachers can instill attitudinal changes in their student by embarking on imprecision of materials needed for teaching. Improvisation of materials will go a long way to find time teaching of the student when local materials are sourced to make them.

2.5.0 Waves

Physics generally of secondary school level is divided into the following parts

- Mechanics
- Heat and temperature
- Electricity/magnetism

- Waves
- Advances physics.

Each part playing its role in the student's ability to put science into practical applications. Waves are one of the widest parts of physics because it encompasses areas, such as of light, sound, musical instrument etc. All aspects of waves both mechanical and electromagnetic waves have common properties except that mechanical waves can not be plane polarized.

2.5.1. Properties of Waves.

The properties of wave are one aspect of waves that forms the basis for whatever knowledge any physics student will develop in waves. The properties of waves are divided into four, they are:

- Reflection
- Diffraction
- Interference
- Refraction

All waves' posses the above mentioned properties and so, the properties of waves is one area under waves that keeps reappearing as the student study all aspects of waves. That gives the reason why improvisation on this vital aspect will create a great impact on the students learning achievement.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter dwells on materials and methods adopted for this research work. It thus focused on the following sub-headings: Research design, Population, Sampling and sampling techniques, Instrumentation, Scoring, Method of data collection and, analysis.

3.2 Research Design

This study adopted the Quasi experimental research design in which the pretest - post test control group design was used. It can be illustrated as in Table 3.1 below.

Table 3.1 Research Design Illustration.

R	Q_1	X	Q_2	Experimental group
R	Q_3	Y	Q_4	Control group

Source: Oguduluwa et al (1997)

Where;

R= Randomization.

Q_1= Pretest data for experimental group.

Q_2= Post test data for experimental group.

Q_3= Pretest data for control group.

Q_4= Posttest for control group.

X= Treatment.

Y= No treatment.

The two groups were drawn from a homogenous or the same population. The allotment of subject to groups was through randomization, (R). One of the groups, (experimental groups) was exposed to a treatment of a particular experience; the other group, (control group) was not exposed to the treatment. The purpose of the design was to compare gain

scores of the two groups. The gain score for the experimental group will be Q_2 minus Q_1, while the gain score for the control group will be Q_4 minus Q_3. The two groups were taught using the normal conventional method of teaching after which they were pre-tested. And at the end of the treatment to the experimental group and the control group taught without the treatment, a post test was administered to the two groups on achievement and two weeks later a post test on retention ability.

3.3 Population of the Study

The population for the study comprised all Senior Secondary schools offering Physics in Suleja Metropolis. The research targeted the senior secondary two students (SS II).

3.4 Sample and Sampling Techniques

A three stage sampling technique was employed in selecting the sample. A purposive sampling technique was first employed to select the two samples senior secondary schools, because the schools offer Physics and their gender composition (male and female).

Secondly, a simple random sampling technique was used to assign the four schools selected to experimental group and control group respectively.

Finally, sixty students were randomly selected from each of the sampled school, making a total of 120 students in all.

3.5 Instrumentation

3.5.1 Development of Instrument

Physics Achievement Test (PAT) was developed from West African Examinations Council, (WAEC) and National Examinations Council, (NECO) examination question papers which covered the topics treated from 1988-2011. The questions were objective containing twenty questions in which the students were required to choose the best option lettered A to D. (See Appendix)

3.5.2 Development of Improvised Instructional Materials

The improvised instructional material was designed and constructed by the researcher using metallic materials which are readily available and affordable as well. The instructional materials covers the four major properties of waves which are-

- Reflection.
- Refraction.
- Diffraction.
- Interference.

Procedure for developing the improvised instructional material, involved the use of metals cut into required shape and welded together to form each of the properties listed above. Therefore the major raw material is a metal and paint for polishing.

3.5.3 Validity of the Instrument

Although the items were drawn from internationally and nationally validated question papers, the items were still subjected to expert validation by a team comprising of one expert in physics, in the Department of Physics, Federal University of Technology Minna, the project supervisors and three physics teachers from schools in Suleja Municipal Council Area for content and criteria validity.

3.5.4 Reliability of the Instrument

A pilot test was conducted using Test – retest method, to determine the reliability of the test items. There was an interval of two weeks between the first administration and the second one. Sixty students were randomly selected from Suleiman Barau technical college Suleja for the pilot test. The data were collected and analyzed using Pearson's Product Movement Correlation Coefficient (PP.MCC) and r = 0.90 was obtained which shows that the items were reliable.

Each correctly answered question attracts a score of one mark which was later converted into percentage to arrive at the total score.

3.6 Method of Data Collection

Physics Achievement Test (PAT) was used to obtain pretest and post test data for the research study. The experimental and control group were pre-tested before the administration of the treatment. The result was collected and analyzed to determine their entry behavior. The second test which is post test was administered to the two groups after the treatment and two weeks later, another post tests on retention was administered to the two groups.

3.7 Method of Data Analysis

The mean score and standard deviation was used to analyze research questions, while t-test statistical analysis was used to analyze post test data on performance and retention using the 13.0 version of Statistical Package for Social Sciences (SPSS). The hypotheses were tested at 0.05 alpha of significance level of probability.

CHAPTER FOUR

RESULTS

4.1 Introduction

Data collected from pretest, post test were analyzed. Thus, research question one to six were answered using mean, standard deviation and t-test in accordance with the associated hypothesis which was tested at 0.05 level of significance.

4.2 Presentation of Results

The data for the study were presented under the following headings:-

(i.) Demographic data.

(ii.) Pre-test Result

(iii.) Testing of hypothesis.

4.2.1 Demographic Data

In this section, the following tables 4.1 – 4.2 indicate the subjects' demographic data in terms of gender and instructional strategy groups.

Table 4.1 Distribution of Subjects by Groups

Groups	Number of students	Percentages
Experimental	60	50
Control	60	50
Total	**120**	**100**

Table 4.1 indicates that 60 subjects representing 50% were categorized into the experimental group while another 60 subjects representing 50% of the sample were grouped as the control group.

Table 4.2 Distribution of Subjects by Gender.

Groups	Male	Female	Total
Experimental	30	30	60
Control	30	30	60
Overall total	**60**	**60**	**120**

Table 4.2 above shows the distribution of students according to gender and groups. From the table, 30 students of the sample in experimental group were male while 30 students were females. For the students in the control group 30 of the sample in this group were males while the other 30 were females. A thorough examination of these data indicates that the male and female respondents in both groups were equal.

4.2.2 Pretest Results

Table 4.3 Mean and standard deviation of experimental and control group before the treatment

Variable	N	df	$\bar{x}$	SD
Experimental Group	60		46.22	6.32
		118		
Control Group	60		47.12	6.85

Table 4.3 shows that the mean score of the experimental group before the treatment is 46.22 and that of the control group is 47.12 with only a marginal difference of 0.90 which is not significant. Based on the above, it can be deduced that the experimental and control group are equivalent in terms of entering knowledge of the subject physics before the treatment and therefore the groups were considered satisfactory for the study.

The answers to the research questions and hypothesis have been presented in tables with brief interpretations.

4.2.3 Research Question One

What will be mean difference between the experimental and the control group in the post test after treatments?

4.2.4 Pretest Results

Table 4.4 Mean and standard deviation of experimental and control group in the Pre test

Variable	N	df	$\overline{x}$	SD
Experimental Group	60	118	63.67	7.85
Control Group	60		56.33	6.42

Table 4.3 shows that the experimental group has a mean score of 63.67 with standard deviation of 7.85. The control group has a mean score of 56.33 and standard deviation of 6.42. From the table it can be deduced that there is a significant difference in the mean score of the experimental group (63.67) and control group (56.33) after the treatment. The experimental group with a mean achievement score of 63.67 did better than the control group with a mean of 56.33. The mean score of the experimental group differ significantly (with a mean difference of 7.34) from that of the control group.

4.2.5 Research Question Two

What will be the mean difference between the male and female student in the post test of the experimental group after treatment.

Table 4.5 Mean and Standard Deviation of male and female in the experimental group in the Posttest.

Variable	N	df	$\bar{x}$	SD
Experimental Male	30	58	65.51	7.85
Experimental Female	30		64.95	7.60

Table 4.4 shows the mean and standard deviation of male and female of the experimental group. The mean and standard deviation of male students are 65.51 and 7.85 respectively while the mean and standard deviation of the female are 64.95 and 7.60 respectively. From the result, the mean of the male did not differ significantly from that of the female.

4.2.6 Research Question Three

How will the mean difference between the experimental control group be on delayed post test?

Table 4.6 Mean and Standard Deviation of the experimental and control group in the delayed posttest.

Variable	N	df	$\bar{x}$	SD
Experimental Group	60	118	64.16	7.60
Control Group	60		51.00	6.35

Table 4.5 shows the mean and standard deviation of the experimental and control group in the delayed posttest. The mean and standard deviation of the experimental group are 64.16 and 7.60 respectively. While the mean and standard deviation of the control group is 51.00

and 6.35 respectively. From the result the mean of the experimental group differ significantly from that of the control group with a mean difference of 13.16.

4.2.7 Research Question Four

What will be the mean difference between the male and female student in the delayed posttest of the experimental group?

Table 4.7 Mean and Standard Deviation of Male and Female in the delayed Posttest in the Experimental Group.

Variable	N	df	$\bar{x}$	SD
Experimental Male	30	58	64.17	7.45
Experimental Female	30		54.40	6.08

Table 4.6 shows the mean and standard deviation of the male and female in the experimental group in the delayed posttest. The mean and standard deviation of the experimental male is 64.17 and 7.45 respectively, while that of the experimental female is 54.40 and 6.08 respectively. From the result there is a mean difference of 9.7 which differs significantly.

4.3.0 Research Hypotheses

HO_1: There is no significant difference between the mean performance scores of students taught physics with improvised instructional materials and those taught without them.

Table 4.8 Mean Standard Deviation and T-test Analysis of Posttest Achievement Scores between Experimental and Control Group.

Variable	N	df	$\bar{x}$	SD	t-cal	Sig.(2-tailed)
Experimental Group	60		63.67	7.85		
		118			2.87*	0.03
Control Group	60		56.33	6.42		

Significant at 0.05 alpha levels

The result on table 4.7 shows the t-test result of experimental and control group. The mean score and standard deviation of the experimental group was 63.67 and 7.85 respectively while the mean and standard deviation of the control group was 56.33 and 6.42 respectively which was significant. The t-value was significant at 0.05 level of significance (t= 2.87, df 118, p< 0.05). therefore, the hypotheses which states that There is no significant difference between the mean performance scores of students taught physics with improvised instructional materials and those taught without them is hereby rejected.

HO$_2$: There is no significance difference between the mean performance scores of male and female students in the experimental group taught physics with improvised instructional materials.

Table 4.9

T-test analysis of posttest performance scores between the Male and Female in the Experimental Group

Variable	N	df	$\bar{x}$	SD	t-cal	Sig.(2-tailed)
Experimental Male	30		65.51	7.85		
		58			0.14*	0.66
Experimental Female	30		64.95	7.60		

Not significant at 0.05 level.

The result on table 4.8 shows the t-test result of the male and female in the experimental group. The mean score and standard deviation of the experimental male is 65.51 and 7.85 respectively, while the mean score and standard deviation of the experimental female is 64.95 and 7.60 respectively, which was not significant. The t-value was not significant at 0.05 level of significance ($t = 0.14$, $df = 58$, $p > 0.05$). Therefore, the hypotheses which states that There is no significance difference between the mean performance scores of male and female students in the experimental group taught physics with improvised instructional materials is therefore not rejected.

HO_3: There is no significant difference between the mean retention scores of students taught physics with improvised instructional materials and those taught without them.

Table 4.10 T-test Analysis of Retention Scores between the Experimental and Control Group.

Variable	N	df	$\bar{x}$	SD	t-cal	Sig.(2-tailed)
Experimental Group	60		64.16	7.67		
		118			2.33*	0.03
Control Group	60		51.00	6.85		

Significant at 0.05 alpha level

The result on table 4.9 shows the t-test of the experimental and control group on retention. The mean score and the standard deviation of the experimental group is 64.16 and 7.67 respectively. The mean score and standard deviation of the control group 51.00 and 6.35 respectively which was significant. The t-value was significant at 0.05 level of significance ($t = 2.33$, $df = 118$, $p < 0.05$) Therefore the hypotheses which states that there is no significant difference between the mean retention scores of students taught physics with improvised instructional materials and those taught without them is hereby rejected.

HO_4: There is no significant difference between the mean retention ability scores of male and female students in the experimental group taught physics with improvised instructional materials.

Table 4.11

T-test analysis of Retention Score between the Male and Female in the Experimental Group.

Variable	N	df	$\overline{x}$	SD	t-cal	Sig.(2-tailed)
Experimental Male	30		64.17	7.45		
	58		2.61*	0.04		
Experimental Female	30		54.40	6.08		

Significant at 0.05 level.

The result on table 4.10 shows the t-test result of experimental male and female on retention. The mean score and standard deviation of the experimental male was 64.17 and 7.45 respectively while the mean score and standard deviation of the experimental female was 54.40 and 6.08 which is significant which differ significantly. The t-value was significant at 0.05 alpha level of significance (t= 2.61, df = 58, $p < 0.05$). Therefore the hypotheses which states that There is no significant difference between the mean retention ability scores of male and female students in the experimental group taught physics with improvised instructional materials is hereby rejected.

4.4 Discussion of Results

Student found it difficult to pass physics at the Senior's Secondary Certificate Examination (SSCE) because the teaching of physics have been rendered abstract due to the fact that teachers no longer exploit the natural environment and they no longer aPp.ly innovative Ideas to teach the subject (Ugwu 2008). This fact is being suPp.orted by the

findings of IGS (2000) who noted that science teaching and learning can only be meaningful and effective if backed up by the necessary resources to enrich instruction.

The result in table 4.4 revealed that the student taught physics with improvised instructional materials performed better than those taught without them. The experimental group have a group have a mean score of 63.67 and control group have 56.33 which shows that, the use of improved instructional materials contributed positively to the learning achievement of student in physics. The test of the hypothesis shows dft=118, SD= 7.85 and 6.42 respectively for the experimental and control group and the t-value calculated 2.867 is not significant (0.03< 0.05) alpha level.

The t-test for the hypothesis one show that there was significant difference in the learning achievement among physics students taught with improvised instructional materials. The result is in agreement to previous finding of Ango (1990) and Ngoka (1992) as well as the findings of Dawodu (2007), Ayodele (2001), Cirfat, Zumyul and Tongjura (2006) who noted that there was significant difference in the performance of student expose to a particular treatment. It is also supported by findings of Nsofor (2004) who noted that students learn more from science lesson when they are taught with learning or teaching aids.

This result is contrary to the findings of Delialiogle and Yoldrin (2008), Serger and Verhoeven, Nwuchukwu et al (2006) among offers who noted that there was no significant difference between the performance of the experimental group and control groups when diagrams, instrumental models, models and styles were administered on different groups of students. The study also revealed that students taught with improvised instructional materials participated more actively than those taught without them as revealed from the mean score of 63.67 by the experimental group against 56.33 scored by the control group with a mean difference of 9.77 which is significant. This is supported by the findings of (pine and west 1986) and Nwachukwu et al (2007), Alaezi (1990), Obiawu and Azubike

(1999), Wasaagu (2000), Olumotumi and Fenso (2000), Adeniyi (2001), Nsorfor (2004), Balogun (2004), and Okwo and Iliya (2004). Who all noted that using teaching aid help students to show more interest in learning than teaching without them. They also noted that facilities motivate the students and also help them to recall easily. From the result, it can be deduced that Instructional materials provide new learning stimuli, enlarge the students and motivate student's response. Instructional materials capture the audience interest and eliminate boredom, speed, and accuracy are some of the qualities instructional media Mkpa (2001), Okiwoand Ilioya (2006). Similarly they noticed that instructional materials in teaching provide opportunities to the students to respond and in some cases, the respond modify the materials which provide further stimuli.

Table 4.4 revealed that the males in the experimental group did not do better than the female in the experimental group. The male had a mean score of 65.61 against 64.95 of their female counterparts in the same group. The experimental male had a SD=7.85 against 7.60 of their female counterparts in the same group which is not significant at 0.05 alpha level, p is greater than 0.05, therefore the hypothesis is not rejected, that is to say there is actually no significant difference between the achievement mean score of the male and the female exposed to the treatment in the experimental group males and females. The result is thus in agreement with the previous findings of Obe (1989), Ibitoye (1996), Awoniyi (2000), Balogun (2000), Nwogu (2005) and Gbodi et al (2002). But the findings is in contrast to the work of Soyibo and Ezeiroma, in Nwachukwu et al (2007) who noted that males did significantly better than their females counterparts when demonstration method on different levels of students cognitive achievement was administrated in secondary biology. Also Okwo and Otubah (2001) reported that boys did better than girls in physics essay test, Nwachukwu et al (2007) reported that the female in the experimental group had a higher mean score than males in the experimental and control groups (page 56), Science Teachers Association of Nigeria (STAN) 2007.

The result thus is in agreement with the findings of Farkouh (2010) who discovered that gender has no influence on students when system approach for conducting practical chemistry was used. It is also in agreement to Ogle (2002) finding that boys and girls have equal potential and tendencies to excel in science-based courses. In another view, it is in disagreement to the findings of Benthan (1964), Gambari (2004), Gimba (2006) and Sabamowa (2006) who found that there was a significant difference in the achievement of boys and girls taught physics and mathematics with instructional models and computer.

In Table 4.5 it was discovered that the retention ability of students taught properties of waves in physics through the use of improvised instructional materials differs. The table showed that the experimental group performed better than the control group when the two groups were retested after a period of two weeks with the mean score of 64.17 and S.D= 7.60 against 51.00 and 6.35 of the control group. The t-value calculated is 2.33 at 0.03 alpha level.

The t-test result of hypothesis three revealed that there is a significant difference between the retention ability of physics student taught with improvised instructional materials and those taught without them. The result is in agreement with the findings of Sergers and Verhoeven (2005), Cepni et al (2006), London (2005), Okwo and Iliya (2006) among others who noted that the experimental group did better than the control group on posttest retention ability as in Okwo et al (2006). It is also in agreement with the previous findings of Chu (2001), Gbamanja (1991), Edokpa and Orheruta (1992) who all discovered that the use of realia, specimens, natural environment makes learning easier and enhances better understanding and longer retention of factual concepts. They emphasized that instructional materials in the local environment aids reality to life and classroom teaching as well as facilitates retention and transfer of learning.

In table 4.6, it was discovered that the experimental males retained better than their female counterparts in the same group with mean retention score of 64.17 greater than 54.40 of

the females. The t-value calculated is 2.61 at alpha less than 0.05 level of significance. The t-test result revealed that the null hypothesis four is rejected as there is significant difference between the post-posttest mean achievement scores of the males and females from the experimental group. The result is in agreement with the findings of Laleye (2004), Opera (2003), Gambari (2004), Gimba (2006), Nwogu (2005), Sabamowa (2006) and Nwachukwu et al (2007) who found that there was a significant difference in the retention ability of boys and girls taught physics and mathematics with instructional models and computer. On the contrary, the findings is in disagreement with the findings of Obe (1989), Ibitoye (1996), Awoniyi (2000) and Balogun (2000), Soyibo and Ezeiroma (1987) and (2000) who all discovered that gender does not have any influence on retention ability of pupils when taught with real objects.

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS.

5.1 Introduction

Living is the aspect of life that has the potential to change, the individuals life positively and even the entire community, because, if what is learn is put to use, it has the potentials to bring massive development. Science teaching and learning can only be meaningful and effective if backed by the necessary resources to enrich instruction (Kehinde, 2004). It has been recanted by many researches that resource are patent tools which world be used to effectively communicate science, technology and mathematics while enriching the learning experience of learners; in Science Teachers Association of Nigeria (STAN) 2006 proceedings.

- A resource stimulates thinking and concretizes students learning. It is thus vital to harness resources outside the classroom such as exist in the environment and community (Adoyanju 2000).

5.2 Summary of the Study

The study investigated the effect of the use of improvised instructional materials on students' achievement and retention on the properties of waves among students in Suleja Metropolis of Niger State as a case study. Four research objectives were raised four research questions and their corresponding research hypothesis were formulated respectively. Some key words were operationally defined. The study reviewed literature related to the research topic. Prominent among them is the importance of using improvised instructional materials to teach and learn physics among secondary school students.

Quasi experimental research design (pretest-posttest control group design) was adopted for the study. Purposive sampling techniques were used to select the school. Simple random sampling technique was used to draw the sample of 120 students. A Physics Achievement Test (PAT) was used as an instrument for data collection. The items were validated by two experts from the Department of Physics, Federal University of Technology, Minna, Niger

State and three other experts of the subject in the sample schools. The items were also subjected to reliability test (test-retest method) and reliability co-efficient of r = 0.76 was obtained. The data obtained was analyzed using t-test statistical analysis method. Three of the four null hypotheses were rejected while one was not rejected.

It was discovered that students the use of improvised instructional materials enhanced students' performance and retention in properties of waves compared to those taught without them. Again, male students taught with improvised instructional materials retain knowledge better than the female students. Not withstanding, the use of improvised instructional materials was found to be gender friendly before the posttest. Educational implications of the findings were discussed and relevant recommendations and suggestions for further studies were made.

5.3 Major Findings of the Study

The major findings of the study are a follows:

- Students taught the properties of waves using improvised instructional materials performed better than those taught without them.
- The use of improvised instructional materials in teaching the properties of waves enhances the performance of male and female equally.
- Students taught with improvised instructional materials retain knowledge better than those taught without them.
- The males taught with improvised instructional materials retain knowledge more than their female counterpart.

5.4 Contribution of the Study to Knowledge

Physics is a basic required subject for all aspiring Engineering students and Scientist. It is one subject that forms the core of Engineering and Technological development. The glaring challenge in Nigeria secondary schools physics teaching is the use of improvised instructional materials to reduce the abstract nature of some concepts in physics. The study will therefore be helpful in:

- Enhancing learning
- Bridging the gap between gender inequality in learning physics
- Encouraging improvisation which promotes retention ability
- Curriculum developments to encourage curriculum developers so as to inculcate the improvisation of the properties of waves in physics curriculum

5.5 Conclusion

The researcher concludes that the use of improvised instructional materials as discovered in this project work will enhance, stimulate and motivate the teaching of physics in schools and colleges. Based on the findings of the researcher, the following conclusions were drawn:

- Improvised instructional materials are effective in enhancing learning.
- The use of improvised instructional materials helps students to retain what they have learnt.
- The use of improvised instructional materials is gender friendly.
- The use of improvised instructional materials is gender biased in teaching the properties of waves because it favours the boys as far as retention of what is learnt is concerned.
- Although the boys did better than the girls on retention in the use of improvised instructional materials, but the girls didn't do badly from the mean score of the retention result, therefore, improvised materials should be used for the girls.

5.6 Recommendations

Based on the findings available as a result of this study, the following recommendations are made.

1. The physics teacher should always endeavour to improvise instructional materials for effective teaching and learning.

2. Government, Philanthropist, Non-governmental Organizations should come to the aid of the schools and colleges that offers physics by providing a befitting laboratory for improvised instructional materials.
3. Government and school administrators should make fund available to teachers to encourage improvisation of instructional materials.
4. Physics teachers should be encouraged to attend conferences, seminars and workshops to improve their competence in the use of improvised materials for teaching physics.
5. Physics teachers and laboratory attendants/assistants should be trained and retrained on how to produce improvised instructional materials.
6. Improvised instructional materials in physics should be given the desired publicity by educating agencies to enhance learning on the part of the student and help teachers to get use to it.
7. Owing to the fact that improvised instructional materials are gender friendly, it should be encouraged in co-educational schools and single sex institutions. In fact, it will be a serious de-service to the educational enterprise to teach students without improvised instructional materials.

5.7 Suggestions For Further Research

Further research should be carried out to reach the areas that were not covered by this study. This includes;

- The availability of improvised instruction materials in schools and colleges.
- Factors militating against the use, availability and effectiveness of improvised instructional materials in physics.
- Resources utilization in the teaching of the subject physics in colleges and schools.
- Evaluation of the availability of improvised instructional materials for teaching physics in schools.

- Availability of qualified and well trained physics teachers on improvisation in schools and colleges.

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APPENDICES

APPENDIX I

Posttest Scores on Performance

Control Group (60 students)

46	44	56	55	52	50	40	39	43	44
53	55	60	57	55	50	61	65	43	45
44	39	43	49	60	63	58	52	39	39
41	40	40	44	45	43	50	51	43	40
40	44	52	55	60	55	54	48	61	63
59	44	55	47	58	48	59	44	60	61

Experimental Group

62	58	65	67	59	49	70	68	75	67
80	65	59	49	58	49	63	61	64	69
80	67	81	85	63	64	66	55	64	63
59	63	72	63	71	67	72	63	73	64
55	48	53	50	60	51	60	50	63	54
61	61	62	63	64	63	68	69	71	85

APPENDIX II

Posttest Scores on Retention

Experimental Group

60	63	59	42	65	48	65	60	66	53
75	68	78	62	57	45	48	43	51	42
50	46	56	46	59	46	58	40	45	49
58	53	59	54	62	58	65	62	66	63
67	64	68	71	85	53	67	58	69	70
70	60	71	58	75	59	70	56	81	50

Control Group

53	54	54	51	50	49	48	49	49	49
45	39	38	50	39	35	43	34	42	40
43	40	50	46	64	43	53	47	47	50
47	48	61	54	62	53	59	53	58	49
59	49	57	52	49	54	48	52	43	56
52	54	54	54	51	48	52	42	56	43

APPENDIX III

Lesson Note

Date: 20 – 09 – 2011

Class: SS II

Duration: 40 Minutes

Subject: Physics

Topic: Waves

Sub – topic: Types of Waves

Instructional Materials: Strings, water in a trough to demonstrate waves.

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

(i.) Define waves.

(ii.) Mention the four types of waves.

(iii.) Define the types of waves.

PREVIOUS KNOWLEDGE:

Students have the idea of vibrations and disturbances caused by wind and touching objects.

INTRODUCTION:

The teacher introduces the lesson by asking the students to mention what haPp.ens when objects is disturbed by an external force to check their previous knowledge.

PRESENTATIONS:

Step 1:

The teacher defines waves as a process of transferring disturbance from one point to another in a medium without any transfer of the particles of the medium.

Step 2: Demonstration of Waves

Using the string tied to one end of a nail on the wall and water in a trough, the teacher further explain the definition of waves using the teaching aids.

Step 3: Types of Waves

The teacher list waves types as

(a.) Based on mode of transfer. Waves can be divided into

(i.) Mechanical waves.

(ii.) Electrical waves.

(iii.) Electromagnetic waves.

(b.) based on direction of transfer. Waves can be divided into

(i.) Longitudinal waves.

(ii.) Transverse waves.

Step 4:

The teacher defines the various types of waves stating examples of each type.

(a.) Based On Mode Of Transfer.

(i.) **Mechanical waves:** These are waves which require material medium for their transfer e.g. sound waves, water waves, waves in string.

(ii.) **Electromagnetic waves:** These are waves which do not require material medium for their transfer e.g. x-rays, gamma rays e.t.c.

(b.) Based On Direction Of Transfer.

(i.) **Longitudinal waves:** these are waves which travel in a direction parallel to the vibrations of the medium.

(ii.) **Transverse waves:** these are waves which travels perpendicular to the direction of the vibration producing the waves.

EVALUATION –

(i.) Define waves.

(ii.) Mention and define any two types of waves.

SUMMARY –

Based on the result on the evaluation, the teacher summarizes the lesson.

CONCLUSIONS – The teacher concludes the lesson by responding to the questions asked by the students.

ASSIGNMENT: Read on the properties of waves.

Date: 04 – 10 – 2011

Class: SS II

Duration: 40 minutes

Subject: Physics

Topic: Waves

Sub – topic: Properties of waves (Diffraction and Interference)

INSTRUCTIONAL MATERIALS: Improvised instructional materials using metallic materials on properties of waves.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to

(i.) Mention the properties of waves.

(ii.) Define the two types under discussion.

(iii.) Sketch a diagrammatic representation of the type under consideration.

PREVIOUS KNOWLEDGE: The students have been taught waves and the properties of waves in the previous lesson.

INTRODUCTION: The teacher introduces the lesson by asking questions, such as, define waves, mention the types of waves you know. To test the students level of previous knowledge.

PRESENTATION:

Step 1: Properties of waves.

Waves have four major properties, they are,

(i.) Reflection.

(ii.) Refraction.

(iii.) Diffraction.

(iv.) Interference.

In this lesson, we will consider diffraction and interference.

Step 2:

The teacher defines diffraction and interference with the aid of the improvised materials.

EVALUATION –

(i.) State four properties of waves.

(ii.) Define diffraction.

(iii.) Define interference.

SUMMARY –

The teacher summarizes the major points of the lesson based on the response to the evaluation.

CONCLUSION - In conclusion, the teacher responds to questions from the students.

Date: 27 – 09 – 2011

Class: SS II

Duration: 40 minutes

Subject: Physics

Topic: Waves

Sub – topic: Properties of waves (Reflection and Refraction)

INSTRUCTIONAL MATERIALS: Fabricated instructional materials using metallic materials on properties of waves.

Behavioral objectives: at the end of the lesson, the students should be able to

(i.) Mention the properties of waves.

(ii.) Define the two types under discussion.

(iii.) Sketch a diagrammatic form of the types of waves under discussion.

PREVIOUS KNOWLEDGE: The students have been taught waves in the previous lessons.

INTRODUCTION: The teacher reviews the lesson by reviewing the previous lessons and summarizing the major points from the lesson.

PRESENTATION:

Step 1:

Properties of waves

Waves have four major properties –

(i.) Reflection.

(ii.) Refraction.

(iii.) Diffraction.

(iv.) Interference.

Only two will be considered in this lesson, reflection and refraction.

Step 2:

The teacher defines

(i.) Reflection with the aid of the instructional material.

(ii.) Refraction with the aid of the instructional material.

Reflection: This is when waves bounce as a result of meeting a barrier.

Reflection: this is when waves changes direction as a result of moving from one medium to another.

EVALUATION –

(i.) State the properties of waves.

(ii.) Define reflection and refraction with aid of a diagram.

SUMMARY –

The teacher goes over the lesson in summary based on the response during evaluation.

CONCLUSION - The teacher concludes the lesson by responding to questions from students.

APPENDIX IV

PHYSICS MULTIPLE CHOICE OBJECTIVE TEST

1. A string is sustaining a stationary wave when
   A. The frequency of the wave is not proportional to the wave length of the wave
   B. The amplitude of vibration is always zero
   C. Two equal wave are travelling in opposite directions
   D. The wave are longitudinal
2. If the wavelength of a wave travelling with a velocity of 360 ms is 60 m, the period of the wave is
   A. 6s
   B. 3.6s
   C. 0.17s
   D. 0.61s
3. Any line or section through an advancing wave in which all the particle are in the same phase is called the
   A. Wave length
   B. Wave front
   C. Wave amplitude
   D. Wave crest
4. The following types of waves are all transverse EXCEPT
   A. Light waves
   B. Radio waves
   C. Sound waves
   D. Surface wave

5. Longitudinal wave do not exhibit

   A. Polarization

   B. Reflection

   C. Diffraction

   D. refraction

6. RiPp.les on water are similar to light waves in that they both

   A. Have the same wavelength

   B. Are longitudinal

   C. Cannot be reflected

   D. Can be refracted and diffracted

7. When vibration occurs in an air column, the distance between a node and an antinode is equal to

   A. One-quarter of the wave length

   B. One-half of the wave length

   C. The wave length

   D. Twice the wave length

8. A wave of frequency of10 Hz form a stationary wave pattern in a medium where the velocity is 20 cm s-1 the distance between adjacent nodes is

   A. 1.0cm

   B. 1.5cm

   C. 2.0cm

   D. 5.cm

9. A wave has frequency of 2 Hz and a wavelength of 30cm. The velocity of the wave is

   A. 60.0ms-1

   B. 6.0ms-1

   C. 5.0ms-1

D. 0.6ms

10. A boat at anchor is rocked by wave whose crest are 100m apart and whose velocity of the wave is 25ms-1 at what intervals does the wave crest reach the boat?

A. 2500.00s

B. 75.00s

C. 4.00S

D. 0.25s

11. Which of the following characteristics of a wave is used in the measurement of the depth of the sea?

A. Diffusion

B. Interference

C. Refraction

D. Reflection

12. Determine the distance between the consecutive antinodes if the wavelength is 60 cm.

A. 15cm

B. 30cm

C. 60cm

D. 120cm

13. Which of the following waves can propagate through a vacuum?

A. High velocity sound waves

B. Ultrasonic waves

C. Acoustic waves

D. Infra-red waves

14. Which of the following is the exclusive property of a transverse wave?

A. Polarization

B. Diffraction

C. Refraction

D. Compression

15. Vibrations in a stretched spring cannot be polarized because they are

A. Transverse waves

B. Mechanical waves

C. Stationary waves

D. Longitudinal waves

16. The property that is propagated in a travelling wave is

A. Amplitude

B. Energy

C. Wavelength

D. Frequency

17. Transverse wave can be distinguished from longitudinal wave using the characteristic of

A. diffraction

B. refraction

C. polarization

D. reflections

18. The fundamental property of a propagating wave which depends only on the source and not the medium of propagation is the

A. Wavelength

B. Harmonics

C. Frequency

D. Velocity

19. An object place at the bottom of a well full of clear water appears close to the surface due to

A. Diffraction

B. Reflection

C. Refraction

C. Polarization

20. The wavelength of a wave travelling with a velocity of $420ms^{-1}$ is 42m. What is its period?

A. 0.5s

B. 0.1s

C. 1.2s

D.1.0s

21. The change of the direction of a wave front because of a change in the velocity of the wave in another medium is called

A. Refraction

B. Reflection

C. Diffraction

D. Interfere

22. Which of the following type of wave requires a material medium for a propagation

A. Sound wave

B. Micro wave

C. Gamma rays

D. Infra-red

23. A types a wave that does not require a material medium for a propagation is

A. Mechanical waves

B. Electromagnetic waves

C. Longitudinal waves

D. Sound waves

24. The number of cycle completed in one second in a wave is known as

A. Period

B. Amplitude

C. Frequency

D. Wavelength

25. Which of the following waves are longitudinal waves?

A. X-ray

B. Wave produced by a tuning fork vibrating in air

C. Light wave

D. Wave produced by a flute

26. A wave has a frequency of 20Hz. Calculate its period

A. 0.5s

B. 0.6s

C. 0.05s

D. 0.25s

27. Calculate the frequency of a wave with a period of 0.25s.

A. 3Hz

B. 5Hz

C. 4Hz

D. 12Hz

28 The major difference between mechanical waves and electromagnetic waves is

A. Mechanical waves does not require a material medium for its transfer

B. Electromagnetic waves does not require a medium for its transfer

C. Electromagnetic waves require a material medium for its transfer

D. None of the above

29. A note of frequency 2000Hz has a velocity of $400ms^{-1}$ what is the wavelength of the note?

A. 5.0m

B. 200.0m

C. 800.0m

D. 2.0m

E. 0.2m

30. Which of the following has the shortest wavelength?

A. Infrared ray

B. Gamma ray

C. Ultraviolet ray

D. Radio wave

E. Visible light

31. The basic difference between a transverse wave and a longitudinal wave travelling in the same direction in a medium is in the

A. Amplitude of the wave

B. Wavelength of the wave

C. Direction of vibration of the particles of the medium

D. Period of vibration of the particles of the medium

32. A wave of wavelength 0.30m travels 900m in 3s. Calculate its frequency.

A 68Hz

B. 225Hz

C. 270 Hz

D. 1000 Hz

33. A radio wave has a wavelength of 150m. If the velocity of radio wave in free space is 3 x 10^8 m/s. Calculate the frequency of the radio wave.

A. 4.5 x 10^{10} Hz

B. 5.0 x 10^9 Hz

C. 4.5 x 10^9 Hz

D. 2.0 x 10^6 Hz

34. The amplitude of a wave is the

A. Distance between two successive trough of the wave

B. Separation of two adjacent particles vibrating in phase

C. Maximum displacement of the wave particle from the equilibrium position

D. Distance travelled by a wave in a complete cycle of its motion

35. Which of the following are both mechanical and transverse?

A. Water waves

B. Sound waves

C. Micro waves

D. Gamma rays

36. When two waves are super imposed on each other, the following occurrences are possible except

A. Nodal lines

B. Anti nodal lines

C. Dispersion

D. Stationary waves

37. Which of the following properties of waves is exclusive to transverse waves?

A. Reflection

B. Polarisation

C. Interference

D. Diffraction

38. A certain waves has a speed of 20m/s. If the frequency of the wave is 0.25 Hz, Calculate the distance between successive crest of the wave.

A. 5.0m

B. 40.0m

C. 80.0m

D. 50.0m

39. The ability of a wave to spread around corners is called

A. Polarisation

B. Diffraction

C. Dispersion

D. Reflection

40. Which of the following statements about sound wave is not correct? Sound waves can be

A. Reflected

B. Refracted

C. Diffracted

D. Polarised

APPENDIX V

ANSWERS TO MULTIPLE CHOICE QUESTIONS

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

APPENDIX VI

MODELS FOR PROPERTIES OF WAVES