IMPACT OF INQUIRY AND DEMONSTRATION METHODS ON ATTITUDE, RETENTION AND PERFORMANCE AMONG SECONDARY SCHOOL PHYSICS STUDENTS OF VARIED ABILITIES IN KANO, NIGERIA

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ZARIA

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A THESIS SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES AHMADU BELLO UNIVERSITY, ZARIAIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN SCIENCE EDUCATION

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ZARIA

September, 2016

DECLARATION

I SalisuDawakin Kudu SHEHUhereby declare that this Thesis entitled"Impact of Inquiry and Demonstration methods on attitude, retention and performance among secondary schoolPhysics students of varied abilities in Kano, Nigeria" has been written by me and it is record of my own research work. It has not been presented in any previous publication for a higher degree. All quotations and sources of information are fully acknowledged by means of references.

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SalisuDawakin Kudu SHEHU Date

P13EDSC9014

CERTIFICATION

This Thesis entitled**"Impact of Inquiry and Demonstration Methods on Attitude, Retention and Performance among Secondary SchoolPhysics Students of Varied Abilities in Kano, Nigeria"**SalisuDawakin Kudu SHEHUwith Registration Number P13EDSC9014 meet the regulation governing the award of Doctor of Philosophy in Science Education Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my parents late AlhajiShehuTurakiSalihi and Hajiya Halima Shehu and to my Beloved Wife MalamaFauziyyaAliyu and my Childrens, HajaraSalihiShehu, AliyuSalihiShehu, Halima SalihiShehu, Hauwa'uSalihiShehu, SalihiTurakiSalihiShehu, HafsatSalihiShehhu, AminuSalihiShehu and FauziyyaSalihiShehuand to all my Family Members for their moral, spiritual and financial support rendered to me throughout the period of this research work.

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LIST OF ABBREVIATIONS

AAAS: American Association for the Advancement of Science

CESAC: Comparative Education Study and Adaptation Centre

MDGs: Millennium Development Goals

NCCE: National Commission for College of Education

NERD: National Education Researchand Development

NMC: National Mathematical Centre

NMIP: National Mathematics Improvement Project

NSQP: National Science Quiz Project

NSSSP: Nigerian Secondary School Science Project

NSES: National Science Education Standards

NERDC: National Educational Research and Development Centre

NSIP: Nigeria Integrated Science Project

PPMCC: Pearson Product Moment Coefficient of Correlation

PPT: Physics Performance Test

SAPA: Science A Process Approach

SPSS: Statistical Package for Social Science

SERC: State Education Resource Centre

STAD: Students Teams Achievement Division

USNRC: United State National Research Council

WCASQ: Wave Concepts Attitude Scale Questionnaire

OPERATIONAL DEFINITION OF TERMS

Attitude: Refers to the interest, aspiration and behaviour exhibited by Senior Secondary School Students toward studying and learning of Physics.

Retention: The ability to store information which can be easily recalled from the short term memory and long term memory.

Performance: Refer to the achievement scores obtained by students in Senior Secondary Two (SSII) Physics Examinations

Demonstration Method: The display of event or process; it involves a student showing activities in font of a class and explaining as he / she proceeds.

Inquiry Method: Refer to where the leaner with minimum guidance from the teacher seek to discover and create answer to a recognized problem through procedure of making diligent search

Academic Performance: Refer to the results obtained from the test administered immediately after treatment.

Low Ability Students: Refer to group of students who perform poorly at Senior Secondary Two (SSII) Physics Examinations and are easily districted and less able to set about tasks in an organized manner, less able to control their own basic impulses and their destines.

Medium Ability Students: Are the group of students who can record an average Performancein Senior Secondary Two (SSII) Physics Examinations not because they are not capable of doing better, but partly because they can not put in extra effort to attain better performance.

High Ability Students: Are those students who did not scribe their fate to luck or to vagaries of chance but rather to their own personal decision and efforts.

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ABSTRACT

This study investigated the impact of inquiry and demonstration methods on attitude, retention and performance among secondary school physic students of varied ability in Kano, Nigeria. Quasi – experimental design was adopted for the study. A purposive sampling technique was used to select six schools out of thirty nine secondary schools in Dawakin Kudu Education Zone. Five hundred SSII Physics students of varied abilities were used for the study. Physics Performance Test (PPT) and Wave Concepts Attitude Scale Questionnaire (WCASQ) were used to collect data. The reliability of PPT and WCASQ was 0.89 and 0.97 respectively using Pearson Product Moment Correlation Coefficient (PPMC) statistics and Guttman Split – Half Coefficient formula. Six null hypotheses were tested at $p \leq 0.05$ levels of significance using one way Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Kruskal Wallis test and Wilcoxon signedrank test statistics. And the following were the major findings: Students exposed to inquiry and demonstration methods performed and retained the learnt concepts significantly higher than their counterparts exposed to lecture method of teaching. There was no significance difference in students' performances with reference to gender and inquiry; demonstration methods are suitable for students of varied ability levels. There is significant difference in change of attitude and location between the students exposed to inquiry and demonstration methods and counterparts exposed to traditional method of teaching. On the basis of the findings outlined; recommendations were made for the improvement of teaching of the concepts of wave concepts within the context of teaching physics in secondary schools. One of the recommendations is that physics teachers should incorporate inquiry and demonstration methods more into the mainstream of pedagogy in the teaching of physics as they seem to have high potentials for enhancing understanding, performance, attitudinal change and retention on the part of the learners.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Science education has been and will continue to be of tremendous importance to humanity for its ability to explain natural phenomena, as well as playing a very significant role in the technological development of both developing and developed nations. Homby (2006) defined science education as an intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment that is through inquiry and demonstration. Science education is very important in everyday life because there is not one aspect of daily living that science has not made an impact on and its teaching and learning offer students the ability to assess a wealth of knowledge and information that will contribute to meaningful life through involving students for inquiry and demonstration.Aleyideino (2000) opined that science education is accepted worldwide as bedrock of human development and progress. Science is not just a mere accumulation or assimilation of body of knowledge but a process of inquiry that interact with materials to stimulate internal concept of changes that involved students for inquiry and demonstration.(Abubakar, Dan' azumi&Fagbemi 2007). According to Bitrus (2012), science education consists of embodiment of subjects which include physics, chemistry and Biology at senior secondary school level for the involvement of students to learn through the use of inquiry and demonstration method.

Physics occupies a unique position in the school curriculum, and is central to many science related courses such as Engineering, Mathematics Chemistry, Agriculture, Geography and Pharmacy. It is obvious that no students studying these disciplines can do without the knowledge of physics. The present senior secondary school physics curriculum is built on

the conception of science as both product and process. As a process, physics has to do with the skills that are called into play by scientists in carrying out scientific investigation. This implies adopting an inquiry and demonstration methods in the teaching of physics at the secondary school level. As product, physics is viewed as consisting of scientific facts, principles, law and generalizations derived from scientific investigations (Das, 2000). In this study involvement of students in the inquiry and demonstration of scientific facts and principles were investigated.

The study of physics involves the acquisition of practical skill and knowledge of the universe. It therefore enable the learners to acquire these and problem solving and decision making skills that enable learners to respond to widespread and radical changes industry, climatic change, health and economic development. These changes demand the application of knowledge of physics principle at each level of education. Physics Inculcate intellectual honest, diligence and observation in the learners (Das, 2000). Physics is such an experimental science whose laws, formulae and facts are established with the help of experiments by involving students for inquiry and demonstration. It forms the bedrock of the science curricula and is relevant to the development of any nations in the world (Daniel &Lasisi 2009). It is an observed fact that, even the political, economic, social and military strength of the nation in the world today is directly determined by its technological strength and consequently by the quality of science teaching and practice given to its citizens for inquiry and demonstration. It was as a result of the recognition given to physics as a subject in the development of individuals and the nation, that is teaching is accorded a prominent position at the senior secondary level of education as contained in the National Policy on Education (FME, 2005). Physics is not only crucial to Science and Technology, but also a

gateway to understanding many natural phenomena such as eclipse, rainbow, light and radiation (Bunkure, 2008). That is involving students for inquiry and demonstration so as to understand many natural phenomena were investigated.

Many scholars have identified several teaching strategies in teaching physics. This includes lecture, inquiry problem solving, demonstration, guided discovery, project laboratories, field trip/ excursion. But the lecture method is predominately used in our educational institution (Aina, 2009). The lecture method is a traditional method of transmission of knowledge to learners characterized as 'one – way flow of information from the teacher who is always active to the learner who is always passive (Sola &Ojo 2007). The method is the most frequently used method of instruction (Suleiman, 2010).The method does not involve students for inquiry and demonstration.

It is traditionally referred to a didactic approach and has been defined as a teaching technique in which one person, usually the teacher, a spoken discourse on a particular subject (Aminu, 2010). It emphasizes " chalk and talk" in the teaching of physics and indeed an oral presentation intended to present information or teach people about a particular subject and are used to convey critical information historical background theories and equations (Donald, 2000). Lecture method of teaching emphasizes " Talk and chalk" in the teaching of science subjects more than eighty percent 80% of scientific information and principles are delivered as lecture (Bichi 2002). That is in lecture method students is not given any chance for inquiry and demonstration, the method also allows easy handling of large classes with out much stress. Usman (2000) highlighted some limitation of the method which include among others, it does not promote meaningful learning of physics as it applied to hearing only. The difference in student ability is not

considered; because it cannot satisfy the difference in individuals such as slow learners and fast learners; students easily become restless and distractive since their attention span very limited and it encourage rote learning and regurgitation of information without necessarily aiding understanding, that is students are not involved during teaching and leaning, which are supposed to be given chance for inquiry and demonstration. Bruner (1960), Gagne (1965) and Bloom (1956) have convincingly supported the used of the several teaching strategies in teaching science among these science processes, approach are inquiry, problem solving, demonstration, guided discovery, project laboratories. Inquiry and demonstration learning based on the constructivist approach the students have ownership of their learning. That is constructivist approach give the chance of involving students for inquiry and demonstration.

Inquiry method of teaching is a teaching method where the learner, with minimum guidance from the teacher seeks to discover and create answer to a recognized problem through procedure of making a diligent search (Adedoyin 1990). Inquiry teaching according to instructional theories is defined as a technique by which the learner studies scientific phenomenon with the approach of the scientific and using scientific processes such as observation, comparing, classification, experimenting communicating, interring (Kuslom& Stone 1968). To learn by inquiry being acquisitive, curious, asking questions trying to find out things for them self. Inquiry is a process for answering question and problem – solving based on the logical examination of fact and observations (Odunbunni, 1986). Inquiry is a term used in science teaching that involved the use of questioning, seeking knowledge or information or finding out about phenomena. Using this method, students learn not only concept and principles but self direction, responsibility and social

communication. It is a highly interactive step by step approach which involves students at all levels of discussion (Obeka, 2010). It is also the way students learn when they are left alone. In this study students involvement for inquiry was investigated

Inquiry method of teaching is one of the numerous types of science teaching method, used as a treatment variable that is an experimental factor that can be used to help students to understand the concept of learning physics effectively, with the students dominating the discussion. There are different types of inquiry models of teaching. These include inductive inquiry, inquiry / demonstration and deductive inquiry. According to Suchman (2008), the inquiry teaching is the way people learn when they'are left alone, also opined that inquiry is the natural way that human beings learn about their environment. Think for moment about a very young child left in a play yard with objects free to explore. The child, without a coaxing will begin to explore the object by throwing, touching, pulling, banging them and training to take them apart. The child learns about the objects, and how they interact by exploring them, by developing his or her own ideas about them in shot learning by inquiry. Dewey (2009:27) proposed that "inquiry is the active persistent and careful consideration of any belief or supposed form knowledge in the light of the grounds that support it and the further conclusions to which it tends". According Dewey the grounds of "any belief" occur through inquiry processes: reason, evidence, inference and generalization. In this study, the effectiveness of inquiry method investigated to enhance the students'performance and attitude in teaching and learning physics.

Demonstration method is a method of teaching in which sight rather than hearing is the major mean of communication. Though, the two are often combined. It is often effective because, most people more easily remember what they see than what only hear or read

about. It is a method where the teacher illustrates with relevant examples (Obeka, 2010). Demonstration mean an act of showing something by proof or evidence; that is to show and explain how something works or is accomplished so that the students can get the message clearly since they listen, know and see the steps of how something is done. In this study the relevant of demonstration method investigated. According to the Barton (1976), the demonstration method, when properly selected and used will be very effective and successful in the following:

1. In teaching operational skills
2. In developing understanding
3. In showing how to carry out new practice
4. In securing the acceptance of new and improved ways of doing things.

Also Barton (1976), mention that there are seven advantage of demonstration method are as follows:

1) Demonstration attracts and holds student attention and interest
2) Demonstration presents subject matter in a way that students can understand easily.
3) Demonstration convinces those who might otherwise doubt that a thing could be done or that they themselves could do it.
4) Demonstration method is object and concrete
5) Demonstration permits the teaching of theory a long with practice
6) Demonstration yields a high rate of " talk" to "exposure"
7) Demonstration aid in developing local leadership

After the demonstration method has been applied in the teaching - learning process, students will develop more understanding of a procedure or step in doing something that

will improve students' ability of doing science concepts. The following are the procedures in applying demonstration method in teaching waves concept:

i. Planning and preparation: A teacher pans the steps in the demonstrational process, including the thing that should be done and they points to be emphasized with each step. And also prepare apparatus required for the experiment
ii. Introducing of the lesson: The teacher explains the goal of the learning, so that the students know what they will do.
iii. Performance: In performance, the teacher has focus on the students whether they can view the object of what the teacher performed them, the teacher demonstrate each steps slowly and carefully. And add demonstration with illustration and explanations to the students.
iv. Supervision: The teacher asks students to write the goal of previous performance, the method used and all steps demonstration by the teacher.

Attitude has been defined by Peter (2005) as the predisposition to react positively or negatively toward object, idea, institution or people. Thus, if students hold the positive attitude toward a concept of physics when using inquiry and demonstration methods, it is relatively easy to lead them toward desirable objective. Social psychologists have viewed attitude as having three components; Cognitive, Affective, and Behavioral. The cognitive component is a set of belief about attributes toward attitudes' object and its assessment is performed using paper – and – pencil test.The effect component includes feeling about the object and its assessment is performed by using psychological indices while the behavioural component pertains to the way in which people act toward the objective and

the assessment is performed with directly observed behaviours based on inquiry and demonstration.

Attitude may affect an individual's behavior in the presence of attitude object in predictable ways. Attitude according to John (2014) is the tendency to react favourably or unfavourably toward designated object or event. Literally scientific attitude is respect for ethics of science which require inquiry and demonstration. Aderogba, (2012) define scientific attitude as the ability to react consistently, rationally, and objectively in certain way to a novel or problematic situation. Or the ability to do things in a way that rely on proven principle. It is also thought and feelings free from 'superstition, unverified assumption and many times from popular opinion that has no empirical bases.

Therefore, attitude determines the behaviour or how one feels about something or somebody based on inquiry and demonstration. It also implies the manner, reposition, feeling, position with regard to a person or thing when involved for inquiry and demonstration, it is the tendency or orientation (especially) of the mind towards (Dictionary. Com, 2014). If a positive attitude would be cultivated towards a learning activity (inquiry and demonstration), it will likely lead to performancein that teaching and learning activity. Schenkel's (2009) study of elementary school pupil, positive correlation between students' attitude and students performance was found that is students' belief and attitude were found to have the potential to either facilitate or inhibit learning. Lakpini (2006) define attitude as a persons' feeling, thought and predisposition to behave or respond in some particular manner. In this study student's attitude toward a learning activity that is involving students in inquiry and demonstration activities investigated.

Poopola (2010) defines academic performance as an expression used to present students' scholastic standing and which is a function of a various factors such as method of teaching, teachers' qualifications, students' home background, school environment, attitude, interest, among others. Chadau (2002) observed the academic performance as what students are able to gain in the physics performance test (PPT) after completion of the instruction. Achino (2000) consider academic performance to the level of an individual's educational growth in a test when compared with scores of others of the same level. That is in this study the performance score of experimental group and compare with the performance of the control group was investigated. Nnachi (2002), on the other hand, started that science academic performance is quantitative indication we have of the positive result of behavior accruing from the study of science.

Smith, (2010) observed academic performance as a display of knowledge attained or skills develop in schools subject designated by test and examination scores or marks assigned by the subject teachers which involved students for inquiry and demonstration. However, (Mang&Mankilik, 2001) defined academic performance as the display of knowledge attained or skills developed in school subjects designated by test and examination scores and marks assigned by the teachers. In Nigerian schools, the laboratories are ill equipped and the physics syllabus is over loaded (Ajayi 1998 & Ahmed 2008) that is performance in students is influenced by the human resources factors. The Table 1.1 is the summary of Kano State qualifying examination result for physics subject, (2011 -2015):

Table 1.1: Summary of Kano State Senior Secondary Two(SSII) Qualifying Examination Results for Physics (2011 -2015):

S/N	Year	No. of students who sat for the Examination	No. of Pass at credit level	% Pass at credit level	No. of Pass at Pass 7&8 level	% of Pass at Pass 7&8 level	No. of Fail F9	% of Fail
1.	2011	14598	9274	63.5%	2300	15.8%	3024	20.7%
2.	2012	14347	8817	61.5%	2902	20.2%	2628	18.3%
3.	2013	13246	4602	34.8%	3007	22.7%	5637	42.6%
4.	2014	10961	4236	38.6%	1801	16.4%	4924	44.9%
5.	2015	13460	6214	46.2%	2246	16.7%	5000	37.1%
	Total	**66612**	**33143**	**49.8%**	**12256**	**18.4%**	**21213**	**31.8%**

Source: Monitoring and Evaluation Division of Kano State Education Resource Department (2015)

Based on the report indicated in the Table 1.1, the study intends to provide some possible solutions to the persisting low performance among secondary school II (two) physics students of varied abilities resulting into large number of low performers in the subject and negative attitude toward the subject. In this study student's performance toward teaching and learning physics investigated.

Moreover, in the teaching and learning process of physics, the individual's ability levels, age and gender are recognized as essential characteristics of a learner in relation to his achievement. Ability level is a factor that can be expressed in various ways, notably interests, attitude, achievement among others. Other several elements work together to determine the nature of the ability level of an individual which inheritance that can be improved by a sustained remedial work (NTI, 2000).

Grouping students' based on ability may be done at random or in some systematic ways. According to Lakpini (2007), ability grouping is usually done by placing children with basically similar cognitive ability in the same group. She stated that the ability grouping was determined as follows:

- High ability level – Upper 25%
- Medium ability level – Middle 50%
- Low ability level – Bottom 25%

Each of these groups or ability levels is determined by the performance of students based on their continuous assessment grade or achievement test score administered in a research work. In this study student with varied ability toward teaching and learning physics were investigated.

It is equally important to consider retention ability when evaluating learning strategies. Bichi (2001) defined retention as the ability to maintain and later recall information or knowledge gained after learning. However, many researchers have also investigated and defined several variables that affect knowledge retention. Obeka (2010) states that they include the type and content of tasks to be learned amount of original learning, instructional strategy used and length of retention interval. It is common for physics students to learn materials, take examination and forget the materials thereafter. Retention refers to what is learned minus what has been forgotten (Mang&Mankilik, 2001). If the learners must maintain the concepts they learn in physics, methods or techniques such as inquiry and demonstration which require constructing new idea from what is already there in the students mind. Retention is the ability to retain and consequently remember things experienced or learned by an individual at a later time. It takes place when learning is coded into memory. This appropriate code of learning knowledge provides the index that may be consulted so that retention takes place with out an elaborate search in memory lane (Bichi, 2002). Consequently remember things experienced or learned by an individual at a later time were investigated in this study.

The nature of materials to be coded contributed to the quality of retention.Materials are related to the quality of retention interms of their meaningfulness, familiarity concreteness and image evolving characteristics (Ademiyi 1998). Homby (2006) considered retention as the ability to remember experiences, things learnt. Similarly, Kundu and Tutoo (2002) posited that retention is a preservative factor of the mind. The mind acquired the materials of knowledge through sensation and perception. These acquired materials in the mind need to be preserved in form of image for knowledge to develop. Whenever a stimulating situation occurs, retained concepts need to be presented to the learners in a way or method that touches their sub – consciousness which can trigger quick recalling of the concepts being taught or learnt. In this study the students' ability level in teaching and learning concepts of physics investigated.

Bawa (2001) defined retention as an ability to maintain things experience or learned, that is retention can be described as a form of reaction which has been presented in the fast or as a result of orientation or attitude which marks an ongoing perception. He further observed that retention can hardly be exact even in the rudimentary case of role learning. According to Olarewaju (2012), retention is the ability to store information which can be easily recalled from the short and long term memory. In this study the students' retention ability toward learning concepts of physics were investigated.

1.1.1 Theoretical Framework

Theoretical basis for this study is the constructivist theory proposed by Bruner (1960). Bruner theory of learning prefers to promote the acquisition of knowledge through the use of inquiry and demonstration methods. The inquiry and demonstration methods are used

according to this theory as forms of obtaining knowledge for on self by use of mental process. Bruner (1960) opined that the greater the students involvement in the learning process, the greater the learning. Also observed that the learning environment should be learner – teacher centered, especially at the secondary school level because of students' different ability levels learner, master what they get involved in doing and what the teacher also gets involved doing. The study used Bruner theory of learning by involving students with different abilities for inquiry and demonstration during teaching and learning wave concepts of physics

Inquiry and demonstration methods involved process approach and science process approach is the constructive method and theories of constructivism have their origin linked to the psychologist; Piaget (1964), who proposes that humans cannot be 'given' information which they immediately understand and use. Instead human must 'construct' their own knowledge. They build their knowledge through experience which enables them to create schemas – mental models in their heads. These schemas are charged, enlarge and made more sophisticated through two complementary processes: assimilation and accommodation. This means that the student's ability to adapt to his / her environment is a function of assimilation and accommodation. Assimilation and accommodation are two sides of adoptation which according to Mukharjee (2002) is a process of creating matches between one's original observations and new ones that might not exactly fit together, because of students' difference abilities.The study used Piaget(1964), theory learning which proposes that humans cannot be 'given' information which they immediately understand and use that is students of varied abilities using inquiry and demonstration methods can understand and use learnt concepts of physics.

These original observations are called schemas. To adopt to new observation and experience in to schemas requires the use of one of the two techniques, which is assimilating information by putting it together with old schemas. If the observations don't fit in nicely into the existing schemas, the shema is changed or accommodated to fit the observation. Adoptation is driven by the urge to attain an equilibrium state. Assimilation is response to already acquired experience while accommodation is adjustment of a response. The accommodation permits learning to take place. The implication of this is that teaching and learning of science at all stage of a child's development should be learner – centered. The Nigeria Education Council in 1990 therefore, modified and came up with fifteen (15) science process skills these are: Observation, Measuring, Classifying, Communicating, Predicting, Inferring, Using number, Questioning, Controlling variables, Defining operationally, Formulating models, Hypothesizing, Designing experiment and Interpreting data. In this study the students' involvement in the learning process in teaching and learning physics were investigated.

1.2 Statement of Problem

Effective teaching and learning of physics in Nigeria secondary schools has become an important issue that needs urgent attention. It has been observed that the teaching is affecting the performance of students in both internal and external examination negatively and development of sound basis for scientific and reflective thinking as demanded by the National Policy on Education (FME, 2005) can only be achieved when science is properly and adequately taught using appropriate teaching strategies. In spite of the importance of physics among Nigerian students, performanceat the senior secondary schools level had been poor (Bunkure 2014). The desire to know the courses of the poor performance in

physics has been the focus of researchers for some time now; it has been observed that poor performance in the science is caused by the poor quality of science teachers, overcrowded classrooms and lack of suitable and adequate of science equipment among others.

Students performed poorly in physics classes usually too large and heterogeneous in terms of ability level. In addition, the laboratories are ill equipped and the physics syllabus is over loaded (Ajayi 1998 & Ahmed 2008) that is performance in students is influenced by the human resources factors. This implies that the fear of examination and the subject being examined may be uninteresting due to dislike for the teachers, which leads to failure to recall the knowledge acquired. The students may have the ability but unable to achieve due to lack of adequate application of method for the students to be able to achieve as well as his ability permits, it is necessary that the teacher apply method as his disposal. Ali (1998) held that the major difficulty in learning physics is the method by which the subject is being taught and students' ability level to understand and retain. Based on the report indicated in the Table 1.1, the study intends to provide some possible solutions to the persisting low performance among secondary school II (two) physics students of varied abilities resulting into large number of low performers in the subject and negative attitude toward the subject Specifically the study investigated the impact of Inquiry and Demonstration methods on attitude and performance among physics students of varied abilities in Kano State, Nigeria. Also how these methods can be used to enhance students' ability in retention physics concepts. The study also fills the gap on gender related issues that was investigated.

1.3 Objectives of the Study

The purpose of this study is to determine the impact of Inquiry and demonstration methods on academic performance, retention and attitude among secondary school Physics students of varied abilities in Kano, Nigeria. The specific objectives of the study are to:

i. determine whether inquiry and demonstration methods of teaching have impact on academic Performance when compared with Lecture method;
ii. establish if inquiry and demonstration methods of teaching have impact in enhancing students retention ability on wave concept;
iii. investigate whether inquiry and demonstration methods of teaching have impact on attitudes of Senior Secondary Two Physics students taught waves concept;
iv. find out the effect of gender on inquiry and demonstration methods of teaching when students were exposed to wave concepts;
v. determine the impact of inquiry and demonstration methods of teachingon students with varied abilities; and
vi. investigate the effect of inquiry and demonstration methods of teaching on rural / urban Senior Secondary Two Physics students taught waves concept.

1.4 Research Questions.

The following questionsguidedthe conduct of this study.

i. What is the difference in the mean score of students taught Wave Concepts using inquiry and demonstration methods of teaching and those taught with the traditional lecture method only?
ii. What is the difference in retention ability when students are taught Waves Concept of physics using inquiry, demonstration and lecture methods of teaching?
iii. What is the difference in change of attitude when students are taught wave concepts using inquiry, demonstration and lecture methods of teaching?

iv. What is the gender difference when students are taught Waves Concept using inquiry, demonstration and lecture methods of teaching strategies?

v. What is the difference in varied abilities when students taught Wave Conceptsusing inquiry, demonstration and lecture methods of teaching?

vi. What is the difference in the mean score between rural and urban Senior Secondary Two Physics students taught waves concept using inquiry, demonstration and lecture methods of teaching?

1.5 Null Hypotheses

The following Null hypotheses were formulated and tested at $p \leq 0.05$:

H_{O1}: There is no significant difference in the mean scores of students taught Wave Concepts using Inquiry, Demonstration methods of teaching and there counterparts taught with the traditional lecture method.

H_{O2}: There is no significant difference in retention ability of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method.

H_{O3}: There is no significant difference in change of attitude when students are taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

H_{O4}: There is no significant gender difference in the academic performances means scores between students taught Wave Concepts using Inquiry and Demonstration methodsand those taught with the traditional lecture method only.

H_{O5}: There is nosignificant difference in varied abilities when students are taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

H_{O6}: There is no significant difference in academic performance between rural and urban Senior Secondary Two Physics students taught waves concept using Inquiry, Demonstration and Lecture methods of teaching.

1.6 Significance of the Study

The study is significant in the following ways:

i. Inquiry and Demonstration methods might enhance the academic performance and attitude of physics students and science students in general. That is the study would facilitate the improvement of teaching and learning of science in Senior Secondary Schools.

ii. Education planner, science curriculum planner, administrators and principals of the school benefit about the reality of educational practice. And guiding them to encourage their teachers to use Inquiry and Demonstration methods in their teaching and learning.

iii. Professional Bodies such as Millennium Development Goal (MDGs), State Educational Resource Center's (SERC), National Educational Resource Department (NERD) and other related bodies benefit in training their prospective members on the effective use of Inquiry and Demonstration methods of teaching.

iv. Associations such as Science Teacher Association of Nigeria (STAN), Physics Students Association, Science Education Students Association and other related bodies benefit in training their prospective members on the effective use of Inquiry and Demonstration methods.

v. Students traininginstitutions also benefit on how to help them to learn individually and interact positively also encourage individual best performance in physics

subject. That is Physics students will achieve better and have positive attitude toward Physics through the use of Inquiry and Demonstration methods of teaching and hence build stronger foundation to Physics Skills.

1.7 Scope of the Study

This study examined the Impact of Inquiry and Demonstration methods on attitude, retention and performance among Physics students of varied abilities; Kano State, Nigeria. Six (6) Schools chosen as Experimental and Control groups respectively with the sample of five hundred (500) students out of the population of five thousand eight hundred and nineteen (5819) in Dawakin – kudu Education Zone, Kano State, Nigeria.The research was limited to SS II (Physics) students of varied abilities in Dawakin – kudu Education Zone, Kano state. The study covers wave concepts such as: Production & propagation of waves, Type of waves, Properties of waves, Light & Sound waves.The SSII students used because as this level students are well exposed to physics courses through the traditional lecture method. The SSI and SSIII are not be used because; SSI are an introductory level while SS III are the final year level and the students are busy preparing for their final examinations.

1.8 Basic Assumptions: The study has the following basic assumptions.

i. The curriculum used is the same for all the senior secondary school II students in Kano State.
ii. Both Male and Female students are taught Wave Concepts in physics using traditional lecture method.
iii. The physics students are taught by qualified and experienced teachers

iv. The students in the study sample have had adequate introduction to physics lesson via the traditional teaching method such as lecture method but are not exposed to inquiry and demonstration methods.

v. The students have higher attitude on wave concepts when taught using inquiry and demonstration methods.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study investigated the impact of inquiry and demonstration methods on attitude, retention among secondary school physics students of varied abilities inKano, Nigeria. This chapter reviews literature based on the following sub - headings:

- Science EducationConcepts
- Current Trends in Physics Education.
- Teaching of Physicsas a Science Subject at the Secondary Schools
- ScienceTeaching Methods
- Inquiry Approach to Science Teaching
- Demonstration Approach to Science Teaching
- Lecture Method of Teaching
- Retention of Concepts in physics
- Attitude of Students towards Physics
- Students Ability Levels in Science Education
- Gender and Academic Performance in Physics Education
- Overview of Similar Studies
- Implications of the Review for the Present Study

2.2 Science Education Concepts

The improvement of science education literacy among citizens is a vital tool for economic, social and development in any country. In appreciation of this, the Federal Government of Nigeria emphasized the teaching of science education at all levels of our education. This is to enable citizen acquire the knowledge of their environment, develop problem solving

skills, develop desirable scientific attitudes, as well as increase their understanding of the role and functions of science education in everyday life (NCCE, 2003).

Bassey(2005) defined science education as a system knowledge and methodological process by which new knowledge is discovered and also conceives science education as a tool for probing and exploring the unknown based on inquiry and demonstration. Shaibu (2014) observed that science education is a complex human activity that leads to the production of a body of universal statements called laws, theories or hypotheses which served to explain the observable behavior of the universe or part of it and which in themselves have predictive characteristics. That is ability to explain the observable behavior of the universe based on inquiry and demonstration methods. Science education is a particular way of investigating the world and forming general rules about why things happen by observing particular situation (Ajaja, 2007). A scientist determines principles from observations (Mader, 2000). In this study observable behavior of the universe were investigated

According to Philips (2005), science education is the foundation upon which the bulk of present day technological breakthrough is built. These days, nations all over the world including Nigeria are striving hard to develop scientifically and technologically. Since the world is becoming scientific and all proper functioning of lives depends greatly on science education, its relevance as a requirement for technological development of a nation cannot be underrated. The process of science education is unique. Science education is a human endeavor that considers only what is observable by the sense or by instruments that extend the ability of the senses. A scientific investigation entails a series of steps called “the scientific method which involved inquiry and demonstration” (Mader,2000). Scientists

design their experiments with a pretty good idea of the outcome. A scientist integrates all that he or she knows and allows his or her imagination full play in an attempt to get a sense of what might be true. The practical activities in physics provide the opportunities for students to actually do science education as opposed to learning about science, because is more on inquiry and demonstration.

Nzewi (2008) asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a science teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matter. Nzewi(2008) maintained that practical activities should engage the students in hand – on, mind – on activities, using varieties of instructional materials / equipment to drive the lesson home. Nwagbo (2008:41) states that:

> the use of practical activities (approach) to the teaching of physics concepts should therefore be a rule rather, than an option to physics teachers, if we hope to produce students that would be able to acquire the necessary knowledge, skills and competence needed to meet the scientific and technological demands of the nation.

Culturally, relevant science education employs materials based on the culture and history of an ethnic group to illustrate scientific principles and the methodology of science education already in the school science curriculum. Many principles of native knowledge were scientific; using culturally relevant materials for inquiry and demonstration can enhance the scope of science taught (Shaibu,2014).

One inquiry and demonstration – like approach has been called the heuristic (step by step) method by English educator Armstrong 1898); no books are used and no directions from the teacher are given, Schwab (1962) said that science instruction is just “rhetoric (talk) of

conclusion" science; so learners never get to see the processes of science, just the end products. Herber Spencer (1820 – 1903) stated that students should directly contact nature and observe natural objects and then form their own conclusions (object – centered instruction). Inquiry and demonstration learning has been used as a teaching and learning tool for thousand of years. However, the use of inquiry and demonstration within public education has a much briefer history. Ancient Greek and Roman educational philosophies focused much more on the art of agricultural and domestic skills for the middle class and oratory for the wealthy upper class.

It was not until the enlightment, or the age of Reason, during the late 17th and 18th century that the subject of science was considered a respectable academic body of knowledge. Until the 1900s the study of science education had a primary focus on memorizing and organizing facts. Unfortunately, there is still evidence that some students are still receiving this type of science instruction today. John Dewey, a well known philosopher of education at the beginning of the 20th century, was the first to criticize the fact that science education was not taught in a way to develop young scientific thinkers. Dewey proposed that science should be taught as a process and a way of thinking and not as a subject with fact to be memorized. Dewey (2009) supported project learning and said that science learning must include the process aspect of science, not just the interpretation and pressure of others was the learning environment. While Dewey was the first to draw attention to this issue, much of the reform within science education followed the lifelong work and efforts of Schunk (1996). In this study process aspect of science using inquiry and demonstration were investigated

Schunk(1996)was an educator who proposed that science did not need to a process for identifying stableabout the world that we live in but rather science could be a flexible and multi – directional inquiry and demonstration driven process of thinking and learning. Schwab believed that science in the classroom should more closely reflect the work of practicing scientists. Schunk developed three levels of open inquiry and demonstration that align with the breakdown of inquiry and demonstration processes that we see today and this are as followsSchunk(1996:24)

- Students are provided with question and materials and are challenged to discover relationships between variables
- Students are provided with a question; however, the method for research is up to the students to develop.
- Phenomena are proposed but students must develop their own questions and method for research to discover relationships among variables.

Students at all levels of education can successfully experience and develop deeper level of thinking skills through scientific inquiry and demonstration. The graduated levels of scientific inquiry and demonstration outlined by Schunk demonstrate that students need to develop thinking skills and strategies prior to being exposed to higher level of inquiry. Effectively, these skills need to be scaffolded by the teacher or instructor until students are able to develop questions, methods, and conclusions on their own.

A catalyst for reform within North American Science Education was the 1957 launch of Sputnik, the Soviet Union satellite. This historical scientific breakthrough caused a great deal of concern around the science and technology education the American students were receiving. In 1958, the US congress developed and passed the National Defense Education

Act in order to provide mathematics and science teachers with adequate teaching materials.The teams of scientist and science teachers have attempted to bring about far reaching improvement in science education at all levels (NSES, 1996). The commission of science education of the American Association for Advancement of science with financial support from the national science foundation embarked upon the preparation of science programme. Materials were first writing during the summer of 1963 and in each of the subsequent summers through 1967. The effort gave birth to a new curriculum called science education process approach (SEAPA) in August 1969. This curriculum considered the process approach as its main instructional strategy for teaching and learning science.

After a launch of Sputnik by the Soviet Union (late 1950s), inquiry and demonstration instructions received renewed attention in curriculum design. New curricula were developed in the US many with an inquiry and demonstration focus. The US curricula of the 1960s (many with inquiry and demonstration elements) had positive effects on learners. Scymansky(1992) founded that when cumulative results of the research were considered, students in the new programs outperformed those in traditional textbook based classrooms on every criterion measured. After Sputnik, inquiry and demonstration in the curriculum of US according to National Science Education Standards (NSES, 1996) was an instructions in its own standard described how the goal of science teaching should be accomplished. Students will learn science by actively engaging in inquiry and demonstration that are interesting and important to them.

In Nigeria, it was after 1969 (the year in which the first National Curriculum Conference was organized) there were increase conscious effort to modernize science education content and instruction. Toreflects this pedagogical triumph. Such attempt according to Akpan

(1992) have been made through programmes, like the Nigeria Integrated Science Project (NISP) by the science Teacher Association of Nigeria (STAN), National Science Quiz Project (NSQP), National Mathematics Improvement Project (NMIP) by the National Mathematical Centre and National Secondary School Science Project (NSSSP) which was a project of the comparative education study and adaptation centre (CESAC) Now Nigeria Educational Research and Development Council (NERDC). This research work investigated the impact of inquiry and demonstration methods on academic performance and attitude among physics students, which lead the Students at all levels of education, can successfully experience and develop deeper level of thinking skills through scientific inquiry and demonstration.

2.2.1 Current Trends in Physics Education

Science naturally lends itself to investigation and collection of data, but it is applicable in physics education and other related subject areas where people are developing critical thinking and investigation skills. According to Schman (2000), through the inquiry and demonstration strategies, people will develop skills and factual knowledge that supports their answer to a question. They will form a hypothesis, collect and consider information and revisit their hypothesis as they evaluate their data.

According to Nwagbo (2006) there are three dimensions of Science education that are important in the propagation of physics and related subject areas. The first one is the content of science, the basic concept and scientific knowledge. The second one is processes of doing science and scientific attitudes. The processes of doing science are the science process skills that scientists use in the process of doing sciences, since science is about asking question and finding answer to the question. These are actually the same skills that

we all use in our daily lives as we try to figure out everyday questions. The third one is that science education focuses on the characteristic attitude and dispositions of science. These include such things as being curious and imaginative as well as being enthusiastic about asking questions and solving problems. Another scientific attitude is a respect for the methods and values of science. These scientific methods and values include seeking to answer questions using some kind of evidence, recognizing the importance of rechecking data and understanding that scientific knowledge and theories using the six basic science process skills such as: Observation, Communication, Classification, Measurement, Inference, and Prediction. These basic skills are integrated together when scientists design and carry out experiments or in every day life when we all carry out fair test experiments.

Inquiry – based learning is fundamental for the development of higher order thinking skills. According to Bloom's Taxonomy (1976), the ability to analyze, synthesize and evaluate information or new understandings indicates a higher level of thinking (Krathwohl, 2002). According to Krathwohl, (2002), teacher should be encouraged divergent thinking and allowing students the freedom to ask their own questions and to learn the effective strategies for discovering the answers. The higher order thinking skills that students have the opportunity to develop during inquiry and demonstration activities will assist in the critical thinking skills that they will be able to use in physics education and other related subjects because science teacher is the key to implementation curriculum. Therefore, the quality of any program in education is a function of the quality of the teacher;Peni (2008: 34) noted that;

If the science teacher is to reflect the nature of science, then it becomes obvious that the science teacher must possess the understanding of the nature of science-- -- If the science is not congruent with the current interpretation of the nature of science then the instructional outcome will not be representative of science in

spite of all effort that may be expanded by those charge with the development of relevant curricula material.

Ladon and Saleh (1997) in peni (2008: 358) also posited that:

> To teach science effectively at all level, the science teacher needs an understanding of the objectives of teaching science. This should guide the science teacher in selecting the methods to use in teaching any topic. There is also the need for the science teacher to know the nature of science as being knowledge (product) obtained through define processes.

Despite the positions, Audu (1997) observed that the teaching of science, technology and mathematics (STM) are handled by people with inadequate knowledge of what it is really involved. Mohammad (1990) assessing problems affecting the success of teaching and learning science in Kano state reported that more than 80% of the teachers in Kano State still see science as a collection of facts. He opined that such teachers will therefore aspire to see their students accumulate knowledge as much as possible, rather than make them acquire scientific skills through practical presentation of their lessons using adequate instructional materials and methodss. Therefore, this research work used as a way forward in teaching physics in secondary school of Kano State.

2.3 Teaching of Physics at Secondary Schools

Physics is one of the core science subjects taught in the Nigerian secondary schools. Physics is the heartbeat of science, because it plays the basic role of elevating and broadening the horizon of scientific knowledge and providing the ground work for technological growth. Thus, governments in both industrialized and developing countries of the word have in recognition of this role sought to provide greater opportunities for its study by their citizens and to make the teaching of the physics more effective at every level of education (Mkpanang, 2010). The need to study physics as expressed by Mkpanang (2000) is that secondary school physics curriculum was developed to improve

understanding of physics concepts, functionality and application to every life. The objectives of teaching physics at the secondary school level are expressed in the curriculum as published by the Federal Ministry of Education (FME,2005: 23) to:

- provide basic literacy in physics functional living in the society,
- acquire basic concepts and principles of physics as a preparation for further studies,
- acquire essential scientific skills and attitude as a preparation for the technological application of physics and
- stimulate and enhance creativity.

The methods employed by Physics teachers in an attempt to impact knowledge to the learner referred to as methodologyMkpanang (2000). Nwagbo (2006) sees teaching method as the strategies or plan that outlines the approach that Physics teachers intend to take in order to achieve the desirable objective. It involves the way teacher organize and use techniques of subject matter, teaching tools and teaching materials to meet teaching objectives. Sometimes when a teacher teaches and at the end of the lesson, evaluation is carried out and it is discovered that students are unable to carry out the behavioral or instructional objectives. What the physics teacher needs to do is to examine his teaching methods rather than looking at students as the causes. Most untrained teachers point accusing fingers on students rather than on themselves when the students are unable to carry out the expected behavior at the end of the lesson or in examination (Mkpanang, 2000).

One of the most important missing pieces in many modern secondary schools is a coherent and simplified process for increasing knowledge of a particular subject in the secondary schools levels. Students often have difficulty understanding how various activities within a

particular subject relate to each other. Much more confusion results when students try to interrelate the various subject taught at school. Too little effort is devoted to defining important outcomes at the end of high school and planning backwards and across subjects Mkpanang (2000). According to Nwagbo (2006) inquiry based and demonstration based learning can help make these connections. Inquiry and demonstration based learning, students can still learn content of both physics and other core science subjects, but through a series of well planned experiences, they will grasp the larger conceptual context and gain grater understanding. Within a conceptual framework, inquiry, demonstration learning and active learner involvement can lead to important outcomes in the classroom, which actively make observation, collect, analyze and synthesize information and draw conclusions develop useful problem – solving skills. These skills can be applied to future situations that students will encounter both at school and at work.

Another benefit that inquiry and demonstration based learning offers is the development of habit of mind that can last a lifetime and guide learning and creative thinking. The ultimate goal of education has been to teach children to think critically and independently. Inquiry and demonstration are the essential component of science learningNwagbo (2006). Obeka (2005) suggested that inquiry type laboratories are central to learning science since students are involved in the process of conceiving problems and scientific questions, formulating hypotheses, designing experiments, gathering and analyzing data and drawing conclusions about scientific problems or phenomena. John (2009) argued that students who experience inquiry and demonstration activities come to understand that they are able to acquire knowledge they desire, in virtually any content domain in ways that they can initiate, manage, and execute on their own and that such knowledge is empowering. Inquiry and

demonstration instructional methods is not merely having students projects but rather strives to nurture deep discipline – based way of thinking.

A number of studies have focused on the differential effectiveness of various instruction modes on learning outcome for learners in different stages of cognitive development (particularly the concrete and formal stage) and those with higher and low memory capacity. This research work is based on the theory of cognitive development. Piaget believed that cognitive development is a functional of activity. Activity to him means internal manipulation of objects. He advocates active learner and learner experience with experimental method and instruction involving teaching of principles and abstraction, by having learners reconstruct them in carefully designed educational setting involving experiment and problems. At the senior secondary schoollevel,learners intellectual ability is developed and hence formal operational stage supposedly attained. This open up a better opportunity for a child to manipulate experiment and develop logical thinking skills.

Schman (2000) investigated the effectiveness of concrete and formal instructional procedures between concrete and formal operational students. He found that formal reasoners performed significantly higher score as a result of concrete instruction than from formal instruction. Similar results were obtained in a study carried out by Tiberghien(2003). Result of a study by Musa (200) indicated that intellectual development had a strong influence on the acquisition of problem – solving skills. Normal (1997) founded that formal reasoning was the strongest predictor of process skill outcomes. However, in a study carried out by Demetrious and spanousis (2010), it was found that the inquiring and demonstration approach tended to be superiors to the expository approach in promoting scientific attitudes among learners. In the majority of studies in this area,

performance in science was the only outcome investigated. Science educators advocate the use of inquiry and demonstration approach in the classroom as a means for teaching not only scientific concept and general concept of learning. The study investigates the impact of inquiry and demonstration methods on academic performance and attitude which lead to efficiency in teaching physics because secondary school physics curriculum was developed to improve understanding of physics concepts, functionality and application to every life

2.3.1 Physics as a Science Subject at the Secondary Schools

Physics is one of the basic subjects of science taught at secondary schools and its concepts and techniques underpin the progress of all other branches of science (Murenzi 2009). Physics subjects generate fundamental knowledge needed for the future technological advances that will continue to drive the economic engine of the world. A physics subject is an element of the education of engineers, computer scientists, chemist as well as practioners of other physical biological science (Jayden, 2013).

The main aim of teaching physics as a subject at the secondary school level is to contribute to the performance of the general object of teaching science; and to emphasize the specific nature of physics subject and its relation with other science discipline. Adeyemo (2010) cited some of the aim of teaching physics as a subject:

- Giving the students a scientific knowledge, interpreting their scientific observation, understanding laws, models and theories of natural phenomena and relating physical laws to technological application
- Preparing students for specific careers based on physics and to aware their scientific location

- Making students aware of the scientific methods with all the vigour, intellectual honesty and critical thinking its requires. This consists of practicing the experimental methods in order to develop the skills of observation, data collection and analysis the mathematical formation of the laws of physics and the construction of models and resolution of concrete problems
- Making students understand the scientific message contributed in diagrams, graphs and media.
- Training students to express themselves scientifically through the use of appropriate technology and abstract representation

The study investigated the impact of inquiry and demonstration methods on academic performance and attitude among physics students which aim of teaching physics as a subject at the secondary school level and contribute to the performance of the general object of teaching science; and to emphasize the specific nature of physics subject and its relation with other science discipline

2.4Science TeachingMethods at Secondary schools

There are several methods of teaching and learning science subject in the course of presenting scientific facts, information, principles, and skills on concepts to the students. Some of the methods include: Demonstration, Inquiry, Discovery, Discussion, Project, laboratory, individualized, fieldtrip, excursion and lecture / direct expository methods to mention but a few. Some of these methods which have their characteristic advantages and disadvantages are specific for some situation and categories of students, while other can generally be applied to all categories of students (Atadoga&Onaolopo, 2008).

The science method to be used for effective teaching and learning at all level of education is a matter of great concern to teachers and educators in Dawakin – Kudu Education Zone.Okwilagwe (2000) noted that the method commonly used for teaching / learning process in Nigerian schools is lecture method andis not so effective because the students are not given the opportunity to interact with the environment and maximally develop their intellectual capabilities.

Researches on teaching methods had shown that lecture method had negative effects on students (Okwilagwe, 2000). Such effects include lack of motivation, inability to cover the content of the curriculum, negative attitude toward the subject and poor performance on the part of the students and teachers. Lecture method is often the method of choice when introducing and exploiting new concepts. Lecture allows a great deal information to be passed to the learner and favors handling of large classes. But it does not stimulate students' innovation, inquiry and scientific attitude. It encourage students to cram facts which are easily forgotten (Okwilagwe 2000). Adeyemi (2003) stated that lecture method is inappropriate and ineffective for achieving the high objective of science. For effective teaching to take place, skillful physics teacher need to use many different methods and techniques at his disposal. A carefully designed teaching method can make teaching and learning effective (Chang & Mao 2008). It has been noticed that the methods that results in positive effect on students' learning are those based on collaboration between teachers and / or students(Okwilagwe, 2000). Also the most effective strategies for teachers to help each other in their teaching experience, style and techniques are inquiry and demonstration.

Many researches on methods and procedures indicated that teaching method is not a minor variable and the better the teaching method is, the more likely quality learning will occur

(Walberg, Fraizer& Welch 1986, Marzo& Pollock, 2001). Gibbs (1996) assimilates the fact of improving teaching method as the getting better learning by students. For that reason teachers must constantly asses how well their methods are working to meet students' needs. Teachers should also use their experience, knowledge and skills to adopt the curriculum to instructional methods

Teaching methods can also influence the attitude of students positively or negatively. Olorukoba (2001) reported that, students taught using cooperative learning in science teaching have the positive attitude to the educational benefit derived from group work. Akpan (1992) observed that, the recognition of the superiority of activity – based instructional method over other methods has resulted in the recommendations of the science process skills approach to science teaching as a method of instruction in science classes.Science teachers have to consider certain factors in selecting the methodology for a science, as rightly observed by Atadoga and Onaolopa (2008: 67) as follows:

i. The learners' age, previous knowledge on the topic and general ability. Science teacher must bear in mind that the class may not be homogenous in ability but mixed.
ii. The topic to be taught, the content of the topic including the concepts to be taught must be well understood to make the choice of an appropriate method easier.
iii. The science teacher's effectiveness in handling a particular method. Whatever advantage a method may have, if the teacher is not competent to use it, the students may suffer unduly.

iv. The timing of the lesson is also very important. For afternoon lessons methods that will make the students to participate actively are advocated so that students can be alert and attentive.

v. The class size is a very serious factor in the choice of method of teaching. For example. Choosing a demonstration method for a class of over one hundred students is suicidal, because the teacher will not be able to control or direct the class appropriately.

vi. The available resource at the teacher's disposal will be an important determinant in the choice of teaching method.

Atadoga and Onaolapo (2008) observed that, it is very clear that science teachers cannot be dogmatic in their daily choice of methods of teaching. A science teacher may introduce a lesson with a method, goes on to develop the lesson by one or more other methods and ends the lesson employing a different method. The frequency with the teacher changes his/her method of teaching will depend on the concepts skills or attitude to be developed in the students. In this study; the inquiry and demonstration methods used to enhance the physics students academic performance and attitude.

2.4.1 Inquiry Approach to Science Teaching

Inquiry learning is primarily a pedagogical method, developed during the discovery learning movement of the 1960s as a response to traditional form of instruction where students required memorizing information from instructional materials. The philosophy of inquiry learning finds its antecedents in constructivist learning theories such as Piaget, Dewey, and Vvgotsky, among others and can be considered a constructivist philosophy. In the 1960s, Joseph Schwab called for inquiry to be divided into four distinct levels. This was

later formalized by Marshall Herron in 1971. He developed the Herron scale to evaluate the amount of inquiry within a particular laboratory exercise. Since then, there have been a number of revisions proposed, but the consensus in the science education community is that there is a spectrum of inquiry based teaching methods available. The National Science Education Standard (US National Research Council, 1996) defined inquiry as the ways in which scientist study the natural world and propose explanations based on evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific idea as well as an understanding of how scientists study the natural world. Inquiry as part of science teaching strategies implies two difference instructional goals(Kirschner, Sweller& Clark 2006);

1. Students must gain understanding of how scientists do their work (a passive view of inquiry understanding)
2. Students should gain understanding of how to conduct an investigations using inquiry (an active view of inquiry understanding). The students must have an opportunity to practice these skills if they are to understand and appreciate them.

Inquiry used within an educational setting is recognized as both a learning objective and a teaching methodology. Inquiry activities are developed to give students ample opportunity to explore, apply prior knowledge, examine, extend understanding toward new learning, and to evaluate their progress of developing new understanding (Kirschner, Sweller& Clark 2006). Inquiry in education is most effective when students are able to recognize the importance or validity of their learning and how it can be applicable to their own lives. Banchi and Bell (2008) further stressed that inquiry involves developing questions, making observations, doing research to find out what information is already recorded, developing

methods for experiments, developing instruments for data collection, collecting, analyzing and interpreting data. Outlining possible explanations and creating predictions for future study. There are many different explanations for inquiry teaching and learning and the various levels of inquiry that can exist within those contexts.

Inquiry – based learning is constructivist approach, in which students have ownership of their learning. It starts with exploration and questioning and leads to investigation into a worthily question, issue, problem or idea. It involves asking questions, gathering and analyzing information, generating solution, making decisions, justifying conclusions and taking action (Harpaz&Lefstein 2000). Through, the processes of inquiry, students construct much of their understanding of the natural and human designed worlds.

Inquiry – based learning starts by posing questions, problem or scenarios rather than simply presenting established facts or portraying a smooth path to knowledge. The process is often assisted by a facilitator / teacher whose role is to guide on the side rather than sage on a stage. The teacher scaffolds learning for students, gradually removing the scaffolding as students develop their skills. According to Mayer (2004), the inquiries of students will identify and research issue and questions to develop their knowledge or solutions. Inquiry – based learning approach when correctly implemented can help develop higher – order information literacy and critical thinking skills. The students can develop problem – solving abilities and develop skills for lifelong learning. Mayer (2004) had shown that this approach could be engaged to motivate students because they worked cooperatively and collaboratively to solve problems with deep understanding. Clark (2002) found that although constructivists often cite each other's work, empirical evidence is not often cited. Nonetheless, the constructivist movement gained great momentum in the 1990s because

many educators began to write about this philosophy of learning. Hmelo – Silver, Duncan and chin (2004) cite several studies supporting the success of the constructivist problem – based and inquiry based – learning methods. For example, they described a project called Genscope, an inquiry – based science software application. Students using the Genscope software showed significant gains over the control groups, with the large gains shown in students form basic course.

Miller (1990) opined that inquiry instruction aimed to give students control over their own formation of scientific knowledge, because students become responsible for naming the problem that needs investigation, forming a hypothesis, designing a method for testing their hypothesis, carrying out their methods, analyzing results and finally forming conclusions in form of Science Process Approach, Science education process skills approaches are cognitive and psychomotor skills which employ in problem identification, objective inquiring, data collection, analysis, interpretation and communication. Harlen (1999) described science education process skills as abilities which can be developed by experience and are used to carrying out mental operations and physical action. According to Mei, Charlene &Karine (2007), science education process skills are commonly used to describe a set of broadly transferable abilities that are reflective of what scientists do. Idowu (2009), opined that when one acquires science education process skills of observing, measuring, questioning, designing, experimenting, interpreting, data among others, such a person becomes specially equipped with the tools required for scientific inquiry and demonstration as well as ability to use these skills in the laboratory for variety of investigations.

Science education process skills are grouped into two which are basic and integrated. According to Harlen (1999) the Basic science education processes include observation, measuring, inferring, recording data, classifying, collection and predicting. The Integrated science education process skills include interpreting data, controlling variables, defining operationally, formulating hypothesis and experimenting. Observation is considered to be the fundamental skills needed to discover the broad knowledge required for inquiry and demonstration. Some of the major features of the processes of science education as identified by Sani (2007) include:

- Generalizable (transferable) across content domains and contribute to rational thinking in everyday affair.
- An identifiable behavior of scientist that can be learned by students
- Specific intellectual skill used by all scientists and applicable to understand any phenomena.

Ango (2002) posited that expertise in science education process skills is a basic and integral part of having effective teaching skills. Such expertise obviously is not innate. One is not born with it. To become an expert, one must receive guidance in the way of scientific inquiry and must conduct extensive guided appropriate practice in the use of the skills of scientific inquiry and demonstration. The development of skills of scientific inquiry required that students of science education be provided with appropriate and adequate guidance in their study of science education. This guidance is to be found in the instructional programs provided in all educational levels. The Basic and Integrated science education process skills are explained as follows;

Observation Skills: According to Sani (2007) observation skills are made on a particular event and general principles which are developed from a number of specific and consistent cases. That is the first stage in scientific inquiry. Karen (1998) opined that they are influenced by past experiences often involving instruments (microscopes, telescopes and others). Sani (2007) identified three broad proficiencies that are logically necessary for achieving observational competence to include:

- Making observation well
- Reporting observation well
- Assessing report of observation

Classifying skills: These involve, the ability of the learner to identify, detect and categories certain occurrences or physics concepts based on the relevant features or patterns. Classifying objects according to Mari (1994), involves sorting and arranging objects according to their similarities and differences. During classifying process things or events are organized, categorized and grouped based an observed or measured property to form an easily recognized pattern. Akinmade in Sani (2007) identified six characteristics of a child who attain certain level of competence in using the process given classifying. Thus the child is able to:

- categorize object or system of objects using a given property
- determine with reason an appropriate property and categorize objects or system of object according to that property.
- classifying objects or system of objects according to two or more simultaneous properties, and
- identifying the properties on which a given set of object has been grouped.

Measuring Skills: This involves assigning numbers to observation in quantitative terms, precision and permits more accurate descriptions (Karen,1998). Mari (1994) identified five sub – processes involved during the process of measuring. These are:

a. Ordering object by inspection in terms of magnitude of selected common properties such as linear dimension, area or volume.
b. Comparing quantities such as length, area volume and weight to arbitrary unit.
c. Taking measurement of quantities which depend upon more than one variable.
d. Converting from one system of unit to another
e. Using devising indirect means of measured quantities

Inferring Skills: Occur when a learner is able to abstract a particular feature, pattern and relationship in series of occurrences in physics. It includes making a deduction from results of an inquiry or instance. Ogunleye (1996) perceived inferring as a skill of basing judgment on observation and measurement event. Mari (1994) pointed out that inference involves reasoning from general premise to specific instance, while inductive inference involves deriving preposition from the evidence of specific cases. The following sub – processes are involved in the process of infer ration as identified by Mari (1994):

i. Distinguishing pertinent observation upon which given inferences are based and are extraneous
ii. Drawing an inference from a set of related observation
iii. Stating cause and effect relationship from observations of related events
iv. Identifying and extending inferences to include discrepant event

v. Modifying and extending inferences to include discrepant event

vi. Developing plans to test the validity of inferences

vii. Using inferences from one set of observation to suggest further observation.

Communicating skills: These are the process skills of transmitting acquired information from one person or group to another which may result in charge in behavior. A scientific experience in observation, data collection and discovery need to be communicated to other people (Sani,2007). This will give growth to knowledge and it could be in written words, diagrams graphs or models. However, the following sub processes are involved during the process of communication (Mari, 1994):

- Describing observation vertically
- Describing condition under which observation are made.
- Recording observation in a systematic ways
- Stating questions and hypothesis concisely
- Using tables and graphs to communicate data
- Planning for communication of procedures in a form so that other persons can replicate the experiment
- Using mathematical analysis to describe interpretation of data.

Predicting Skills: Making predictions involves figuring what future observation will be on the basis of available previous information. Akinmade in Sani (2007), identifying some proficiencies associated to a person who achieves competence in using the process prediction suggest that such a person should be able to:

i. find out and explain trends in given set of data

ii. device appropriate procedures for checking the correctness of the prediction made

iii. present plausible argument and evidence to justify his prediction

iv. appreciate the importance of multiple observations in making predictions

v. exercise restraint in making predictions in the absence of reliable and valid multiple observation.

Interpreting of Data Skill: Interpreting takes place when a physics student is able to transform physics information or knowledge from one form to another. Smith and Welliver (1990) defined interpreting as a process of using various forms of data to determine the validity of a hypothesis, to organize information derived from an experiment and / or revise interpretation of data base on new information. Mari (1994) viewed interpreting data as involving identifying charges in size, shape, position and judgment of validity and usefulness of data. However, Akinmade (1992:24) identified what a student should be able to demonstrate competence in the use of the skill as follows:

- Make sound generalization from a set of data
- Identify cause and effect relationship
- Provide reasonable justification for any generalization made.
- Draw as many plausible inferences as are permitted by a given data set
- Test an inference by collecting more data
- Recognize which data lend support to an inference.

Raising Questions and Formulating Hypothesis Skill: Mari (1994) viewed hypothesis as a thoughtful educative 'guess' as to what solution to a given problem might be.

Experimenting Skill: This is testing of hypothesis to confirm or disconfirm if initially it might be in the form of trial error. Sani (2007) reported that experiment involves chasing

after answer along a path that appears fruitful. He further, asserted that the achievement of competence in the use of this process skill implies that student is able to:

- Choose, clarify and state the primary variable being investigated in a way that could be tested
- Confine the number of variables to a manageable number
- Competently control variable
- Differentiate between independent and dependent variables
- Select or design data gathering procedures that are appropriate to the investigation
- Use the process skill of observing, classifying comparing and measuring to gather relevant data.
- Ensure the reliability and validity of data gathering procedure employed
- Record and organize data using tables, graphic representation and models
- Use the process skill of inferring and predicting to interpret the data collected
- Find a rational answer to the research questions period
- Raise new relevant questions
- Design new experiments to find rational answers or the new research questions raised.

Controlling Variables Skill: This is the process of identifying the influential in a system, holding some constant and varying others to see how the system behaves.

Forming Mental Models Skill: This is ability to create a mental, physical or verbal representation of idea, objects or events. Mari (2001) identified the following sub – process involved in the formulating of models as:

- Differentiating between models and reality
- Explaining phenomena by using models devised by others
- Constructing a physical representation a drawing or mental image to explain observed phenomena
- Extending physical or mental models to include related phenomena.

In science education process approach, the ability to read is not essential as it is in many traditional curricular. Thus, inquiry and demonstration in science can begin as early as kindergarten. Success does not depend on the reading skill, but on the ability to use the process of science. The implication of this according to Ameh (2001) lies in the provision of equal opportunity to students from low social – economic backgrounds (many of whom may have reading problem), and those students from higher social economic strata. There is, however, several basic assumptions underlying the SEAPA programme.

Ahmed (2004) identified some of these basic assumptions as follows:The first assumption is that science education can be taught to students in an honest and open minded manner. For the SEAPA programme, the primary implication of this is that students should learn no so much the facts which are the outcome of scientific investigation but as process used by scientists. The second assumption is that science education is best by ‘doing’. The third assumption is that the lesson must take into account of the empirical finding of developmental psychology. SEAPA used the insight of the psychologist Robert Gagne as a guide in the programme design which include the nine steps of instruction such as gain attention, provide a learning objective, stimulate recall of prior knowledge, present the material, provide guidance for learning, elicit performance, provide feedback, assess performance and enhance retention and transfer. Each lesson in SEAPA specified the

particular behavioral objective of the lesson. Each lesson also specifies the competency measure for that lesson. This represents a very specific way of teaching and learning science also the unique contribution to the teaching of physics. These processes according to Wuyep (1996) are the foundation for scientific inquiry, demonstration and the generalized intellectual skills selected to learn the concepts and abroad principles used in making the valid inductive inferences.

Akinmade (1996) found out that process approach improve students' ability to apply intellectual skill to solve problems. It also helps the learner become more creative, master science content better; develop position attitude towards science and the scientist. Eniayeju (1994) observed that students who study science through applying science process to solve problem, do learn and remember as many or more facts than those who study science by more traditional methods. Further support for the adoptation of the process approach in science teaching was given by Awodi in Shaibu and Mari (1997) observed that science teacher can not teach effectively without employing the process of science and neither can students learn effectively without the use of the process of science which is assured by the process approach.

SEAPA also produced many textual materials, in form of the teacher guide can engage in training science teachers since it appreciate the role of the teacher in the preparation of learning materials diagnosing the need of the people. Eniayeju (1994) identified additional skills attainable from the process approach which include creativity, counting number relationship, questioning, manipulating, control variables, organization and acquisitive skills.Bichi, (2001) also observed that as students engage in to problems solving, there acquire skills and confidence which aid their capacity to tackle future problems.Hence

science teaching can not be done by listening and reading alone. Students should involve in meaningful activities during which they have ample opportunities to use a functional in intellectual skills called the science process to solve problems.Therefore, in this study the inquiry method used among the teaching strategies, aimed to give students control over their own formation of scientific knowledge for effective teaching and learning physics and used as a way forward in teaching physics at secondary schools of Kano State.

2.4.2 Demonstration Approach to Science Teaching

Demonstration approach is a teaching method which displays an event or process. It involves the teacher or students showing activities in front of the class and explaining it as process. Igboewe (2012) defined demonstration as teaching method which involves experimentation. Uche&Umoren (1998) observed that though demonstration activities are often defined to embrace laboratory experiment, however, the mode of communication prevalent in demonstration strategies is a two way communication with the teacher in this method, the teacher encourages minimal participation from students. According to Igboewe (2012), demonstration is the basic method of instruction for teaching skills, subject matter and performance method of instruction.

Demonstration is essentially a teacher activity aimed at showing how skills, procedure or a process works or done. The purpose is to ask students to acquire the requisite skills or to procure related knowledge. In the discipline of science, demonstration has along history of usage and it basically entails showing how certain scientific equipment operate or a certain operation in science serve to explain a given concept. In the classroom, demonstration may be subjected to uses for posing a problem that requires a solution to illustrate a problem in order to ensure a quick arrival at the solution. Similarly, according toObeka and Ametefe

(2012), demonstration may be applied to proceed or to follow a discussion or it may be used to illustrate the application of a principle. As a rule, demonstration is jointly used with other skills such as explaining, discussion and performing. It can be considered as a variable instructional method if it adequately or significantly serves to improve students learning.

Obeka (2010) opined that demonstration is recommended for teaching skills because it lowers all the necessary steps in the effective learning order. According to him, (Obeka) the demonstration steps give trainees the opportunity to see and hear the details related to the skills being taught. Those details include the necessary background knowledge, the steps or procedures, nomenclature and the safety precautions.

If demonstration is to exercise its effect on the degree of students learning, the physics teacher must do a number of things including specifying the objectives to be attained as a result of the demonstration in advance in order to be confidently sure that it works. Carry out the demonstration at a surface or point that is clearly visible to the entire class, employing the use of simple apparatus or experiment conducting the demonstration at a pace that is meaningful to the students and having adequately involves through out the demonstration sequence or process. It must also be defined that the teacher must prepare for possible question to ask students and those that may be asked by the students. Science teacher must also anticipate probable area of difficulty with the respect to the concept and principle that related to the demonstration, emphasize, safety precaution afford students opportunity of trying their hands on demonstration and finally evaluate students learning that result from the demonstration experience. It is obvious that most of physics teacher will devote a significant amount of their time to the demonstration and inquiry approach.

The physics teacher can employ demonstration approach in the following ways(Uche&Umoren, 1998: 40):

- As a set induction (at the beginning of the lesson to initiate critical thinking for further studies and to stimulate interest)
- As stimulate variation (along the development of on lesson)
- As a lesson closure (that is at the end of the lesson) to summarize the vital point to arose further critical and analytical thinking
- To introduce experimental methods and techniques
- To do simple experiment which do not warrant the time needed to distribute supplies for a class experiment
- To carry out complex experiments
- To verify a scientific concepts
- To solve problems.

Obeka and Ametefe (2012) outlined some of the merit of demonstration approach which include;

i. Demonstration approach can be used as a facilitator to arrest the attention of the students and improve their sense of experience, thus enhancing learning.
ii. It permits the students to observe the process in nature.
iii. It prevents the occurrences of an accident and loss of facilities through breakages when utilize by the teacher to depict the correct use of the facilities.
iv. Demonstration approach may depict how a phenomenon or an event can be expertly demonstrated by a teacher, since less materials and equipment are required.

v. It allow, students to observe scientific activities which otherwise would have been impossible supply because it is expensive, different or hazardous for the students to handle them scientifically.

However, there are many science teaching approaches which are being used in the teaching and learning of physics such as the use of concept mapping, analogy, constructivism, cooperative learning and many, yet it could not solve the problem of poor performance in physicsMkpanang (2000). Therefore, the studytry out demonstration approach of teaching among methods of teaching physics concepts because, demonstration steps give trainees the opportunity to see and hear the details related to the skills being taught in the teaching and learning of physics.

2.4.3 Lecture Method of Teaching

There are various methods that can be used for the presenting scientific fact, principles, information and concepts to students. One of the oldest and most commonly used method however remains the lecture or expository method (Olorukooba 2001& Ada 2006); had inform that the traditional instructional methods referred to a lecture method, the expository method or talk and chalk method of teaching. Olorukooba (2001) described the method as a teacher – centred method in which the teacher does the bulk of the talking as he presents large bodies of facts and principle to many students whose role are relegated to that of passive learners. This description is in agreement with an earlier view by Olorukooba(1983) when she was stated that the method aim at collecting a large body of information to be disseminated to as large a group of people as possible and in the shortest time with minimal cost.

Atadoga&Onaolopo, (2008) also described the method as a didactic approach, defining it as a teaching technique in which one person usually the teacher presents a spoken discourse on a particular subject. They further opined that the method is used for elaborating, simplifying, clarifying and discussing new materials to learners.The method was reported as not being expensive since only the chalk and chalk board are required. It is allows for easy coverage of the syllabus as well as being faster way to communicate scientific information and facts. Despite these points, the method does not auger well for the meaningful learning of science. Since much emphasis is on the sense of hearing. It does not cater for the various ability groups that can be identified in a class. Also it can be boring and frustrating as learners are made to sit for further long – time, writing and listening. It also encourages rote learning with out necessary aiding understanding.

At least, eighty percent (80%) of scientific information or principles are passed on to students through lecture method (Adesoji, 2009). According to Adesoji (2009), many academicians have accepted lecture method as a proper way of importing knowledge since our educational system puts so much premium on external examinations. Lecture method helps a science teacher covers a large amount of material (syllabus) to a large class size in a very short period. This is however a detriment to students' learning, but the teacher may not have a choice being driven by the pressure to cover the syllabus and prepare the students for the external examination which is the only qualifying measure to the next level or employment. However, there are basic problems common to lecture method.

Since the lecture method places as the authority of the subject matter and the controller of the students' behavior, the communication is the only way. The students have limited opportunities to express their problem, conflict, needs, among others. It is difficult to know

if the science teacher is being understood. There is little chance of correcting students misgiving and thus the students are alienated.Bichi (2002), posited that seventy five percent (75%) of the scientific information or principle that students received from their teachers comes through expository method. When science is taught using lecture method, students often rote learn and in the process miss an essential part of the science learning subject to the students of senior secondary school.This study investigates the impact of inquiry and demonstration methods on academic performance and attitude among physics students of varied abilities so as to replace lecture method which helps a science teacher covers a large amount of material (syllabus) to a large class size in a very short period.

2.5 Retention of Learned Concepts in Physics

Retention is defined by Kolb (1984) as a preservative factor of the mind. The mind acquires the materials of knowledge through sensation and perception. The acquired materials in the mind need to be preserved in form of images for knowledge to develop whenever a stimulating situation occurs; retained images are revived or reproduced to make memorization possible. Hence, physics wave concepts need to be presented to the learners in a way or through a method that touches learners sub consciousness which can activate quick recalling of the concepts being taught or learnt.Both high ability and low ability learners would be able to inquiry and demonstrate in terms of understanding, explaining and retaining the wave's concepts they have learnt in a physics class. There is an old concept in science education which supports the idea that most students need hand on laboratory experience to learn concepts. It is based on the cognitive levels of development originally put forward by piaget and implied in the Chinese proverb " I hear and forget, I see and remember, I do and I understand" (Woerner, Rivers &Vochell, 1991).

Study on how individual learner's retain information shows that a person remembers 10% of what he reads, 20% of what he hears, 30% of what he see, and 50% of what he see and reads. These percentages increase for these fortunate enough to read, see and do things in actual practical experiences. This implies that appropriate pedagogical strategies must be used so that students can read, hear, see and do things in actual and practical experiences in order to perform well in physics.Hormby(2005) defines retention in the 7th edition of the oxford Advanced learner Dictionary as the ability to remember things; when wave concepts are taught the overbearing wish of the physics teacher is that concepts taught should be remembered. Miller (1990) stated that in a learning situation, the process of interaction with materials being studied provides a strong learning reinforcement. This wills significantly increase content retention. Particularly with interactive course in comparison benefit of interactive technology, media and videodisc monitor.

Obriger (2001) informed that inquiry and demonstration can incorporate many element that make learning new materials more fun and interesting. According to him Obriger (2001) this result was more effective and better retention of the learning materials. A number of studies which had replayed the role of teaching methods used in delivering instructions to retention ability as well as academic achievement are reviewed in this section.According to Hormby (2006) and Chauhan (2007),retention is the ability of an individual to remember things. Permanent and meaningful learning are ultimate target of our educational endeavor (Chauhan, 2007). Understanding and retention are products of meaningful learning when teaching is effective and meaningful to the students (Bichi, 2002).

A study was carried out by Kwon, Allen and Resemussen (2005) aimed at investigating students' retention of mathematical knowledge and skills in two differential equation

classes. Posttest and delayed posttest after one year were administered to students in inquiry – oriented and traditional classes. The results showed that the students in the inquiry – oriented classes, where composed with those in the traditionally taught classes retained conceptual knowledge as manifested by the performance on modeling problems. They, however, retained equal proficiency in procedural problems. The result added additional support to the claim that teaching for conceptual understanding could lead to longer retention of mathematical knowledge.

In another study carried out by Abu and Flowers (1997) on the effect of cooperative learning approach of Students Teams Achievement Divisions (STAD) on the achievement of content knowledge, retention and attitude of home economics students in North Carolina towards the teaching method, a quasi – experimental design was used to compare cooperative and non – cooperative (competitive) classroom structure. Results of the study showed no significant difference among the dependent variables (achievement and retention) and the teaching methods used.

In a study which included retention treatments, Ikedolapo and Adetunji (2009) compared the relative effectiveness of the guided discovery and concept mapping teaching strategies in retention to students' performance in Chemistry. A t- test statistic was used to analyse the data obtained and the results indicated that there was no significant difference in the mean scores of the students due to post posttest (retention) treatments. It was also observed that gender made no significant difference when the mean scores of the methods adopted were compared on the post posttest (retention) treatment.

In general, factors affecting retention and performance are likely to be complex, multi-faceted and require a joined – up approach in terms of instructional method (Martinez & Mundey 1998). A review of the literature on students' retention (Modi, 2009) formed that the students experience is a significant factor in retention and that the teachers can adopt strategies which will improve retention rates. Kenwright (1996) found that, even where there was considerable individual difficulty, students persisted if they appreciated the course enough, if students felt they were having a useful learning experience, they would battle through family problems, health or money difficulties and remain on the course. This study investigates the impact of inquiry and demonstration methods on academic performance retention and attitude among physics students of varied ability and shows that appropriate pedagogical strategies that is inquiry and demonstration methods must be used so that students can read, hear, see and do things in actual and practical experiences in order to perform well and ability to retained concepts in physics

2.5.1Attitude of Students towards Physics

One of the key aims of secondary school physics is the promotion of enthusiasm and enhancement of interest in physics. This is at variance with what is observed in most cases where people may leave the school with the feeling that physics is difficult and inaccessible (Simon, 2002). Researches into attitude towards physics have shown lack of clarify and agreement towards what attitude are. This is due to the fact that attitude does not consist of a single construct, definition or meaning. Rather it has different sub – constructs, all of which contribute to an individual's attitude toward physics in varying degrees.

Thus, attitude has been defined by different authors in different ways depending on their background, interest and concern. Smith (1998) defined attitude from the psychological

point of view as a relatively enduring predisposition to respond in a relatively consistent manner towards a person, object, situation or idea. Davis (2002) offers a definition of attitude which includes cognitive, emotion and action tendency to particular behavioral intents. Thus, he believes attitude is best viewed as a set of affective reactions towards the object, derived from concepts of belief which the individual has concerning the object and predisposing him / or to behave in a certain manner towards the object. Therefore, behavior rather than attitude is focused on by these two authors.

Perhaps, a definition from a social – psychological perspective such as that given by Mayers (1999) would be more suitable focusing the meaning of attitude in wave's concept. Mayers defined attitude as a favourable or unfavourable evaluative reaction towards something or someone, exhibited in one's belief, feeling or intended behavior. This definition implies that attitude in waves concepts could be positive or negative and may involve subjectivity on the part of the person expressing it and in its measurement. Simon (2002:215) has listed the following components as relevant in the measure of attitude towards physics:

i. The perception of physics teacher.
ii. Anxiety toward physics.
iii. The value of physics.
iv. Motivation towards physics
v. Enjoyment of physics.
vi. .Attitude of peers and friends toward physics.
vii. Attitude of parents towards physics.
viii. The nature of classroom and laboratories.

ix. Fear of failure on a course.

Some of the purposes of research into attitudes are to identify how young people's experiences or perception of physics appear to alienate them from physics as well as how their attitude affect their choice of physics related careers. This study investigated the impact of inquiry and demonstration methods on attitude and academic performance which lead positive attitude toward wave concepts of physics.

2.6Students Ability Level in Science Education

According to Egelson (1996) the students of all mental abilities are found to be mixed in a classroom and they are given the same assignment also are required and indeed expected to do the same work. Ability levels are different types, Peterson (1982) opined that the ability level is the degree of the exhibited capacity of a students to learn and comprehend a concept as well as solve problem. Research Base Information on Timely Topic Magazine (RBITT, 2002) referring to two common form of ability grouping as

1. Within class ability grouping, which refer to teacher practice of dividing students of similar ability in small group and
2. Between class ability grouping, which refer to school practice of separating students into different classes, course sequences or curricula tracks based on the performance.

RBITT (2002), stated that students within class grouping are ability level said to be homogonously grouped while students of different ability level lump or mixed together in ability classes are said to be heterogeneouslygrouped. Also reported that within class ability grouping are slightly produced large again than the mixed ability grouping and the positive

effects are slightly greater or low achievers then the average or above average achievers, then the cross – grade ability grouping where students are regrouping for teaching across – grade ability levels and the non – graded plan, where students divided by performance rather then age, produced grater gain in performance then the mixed ability group class.

Collia (2002) identify three types of students' ability levels via the high ability levels, middle (average) ability levels and low (under) ability levels. Grouping students' based on ability may be done at random or in some systematic ways. According to Lakpini (2007), ability grouping is usually done by placing children with basically similar cognitive ability in the same group. She stated that the ability grouping was determined as follows:

- High ability level – Upper 25%
- Medium ability level – Middle 50%
- Low ability level – Bottom 25%

Each of these groups or ability levels is determined by the performance of students based on their continuous assessment grade or achievement test score administered in a research work. The high ability according to Ofomine (2007) described the high ability level students as students whose academic potentials are above class average and their performance described as good. Emily, Robert, and Michael (2003) have ascribed the high performers as those students who perform well in test, assignment and examinations. Middle (average) performers those are group of students who according Awe (2003) can only record an average performance not because they are not capable of doing better but partly because they cannot put in extra effort to attain better performance. They are

therefore, contented to remain average. For this reason, they content them selves with the classroom learning with out trying to reach out to other information.

Ashilley (2001) described the low performers (underperformers) as the grouped of students who perform poorly in test, assignment and examination also are easily distracted and less able to set about task in an organized manner. And he stressed that these students were less able to control their own basic impulses and destines. Ofimine (2007) described under performers as the students whose academic potentials are judged below class average while their performance as poor. Ayeremoi (2001) contended that the under performers (low performers) need constant study, evaluate and help so as to reverse their condition.

Afolabi and Akinbobola (2009) were of the view that physics students with the low ability level taught with problem based learning technique performed significantly better then those taught with lecture teaching method; Okebukola (1992) conformed that the use of appropriate instructional strategies (inquiry and demonstration) can influence the performance of low performing students. It was discovered that students of intellectual ability according to Alant (2004), students of varying ability levels performed differently depending on the type of method of instruction. Akinbobola (2009) view that the ability levels of the students were found to actually influences the students' academic performance. In this study, therefore the researcher carried out an investigation on the impact of inquiry and demonstration methods on attitude and academic performance of physics student of difference ability levels at senior secondary school in Dawakin Kudu Education Zone, Kano State.

2.7 Gender and Academic Performance in Physics

Schools are in three categories namely; the single schools made up of boys only or girls only and mixed schools made up of boys and girls. In Kano State government policy on education don't allow mixed schools in public schools. The rational for this categorization according to Shaba (1995) and Benjamin (2006) cannot be unconnected with the issue of moral decadence, enrollment explosion and proximity to learners' community. Gender issues has taken important dimension in recent times as result of increasing awareness of the moral implications of the dangers inherent in the marginalization of women who form more than half of the world population. In this study gender issue were investigated.

Research on gender and gender related are inconclusive. Onyewadun (1998) found gender related difference in academic Performance. Alfa (2007) reported that most researchers found boys performing better than girls especially in order knowledge; a few other found girls out performing while others established no significant differences especially during early education. Also, Benson (1997) reported that the largest differences between boys and girls performance lies on the affective domain that is attitude. Mari and Bichi (2008) supported that boys performed well in any rigorous work while girls showed to settle for less rigorous work girls perform better than boys in problem solving type activities.Onekatu and Onekatu (2002) found out that, boys outperformed girls in science education. Science teachers play a vital role in addressing the problem of gender in science education. According to Levi (2000), there are three roles a science teacher must play namely

i. Ensure provision of equal opportunities and respect for differences in the classroom.

ii. Ensure that boys and girls have the same experience and that is, treat boys and girls equally and

iii. Compensate for gender difference in the society.

In order for concepts in physics to be properly learnt and understood, the methods used in teaching the concepts play a vital role and various reasons had been advanced in attempts to rationalize under performance and poor attitude to science subject among students. Oloruko – oba (1983) posited that the inability of pupils to perform to their optimum level of expectation as well as their preference for arts over science could be ascribed to several factors also according to her in (2001), students persistent poor performance has also been partly ascribed to inadequate teaching and instructional methods adopted by the science teachers. Nwagbo (1997) supported that poor performance in and the negative attitude towards science attests to the fact that science teaching has not been properly done. In this study attitude of students toward teaching and learning were investigated.

Agommuoh and Nwezi (2003) had informed that Ivowi, (1984) and Otuka(1987) reported that physics education has been in a deplorable state, hinting that both enrolment of students in physics and performance in physics examination was low.Chimeze(2001) stressed that instructional materials and methods are important in enhancing women participate in science especially when they are introduced to them at tender age through manipulative toys that allow making connections between object and numbers. In this study Inquiry and Demonstration as an appropriate teaching methods were investigated.

Similarly, Nwaigbe (2001), opined that lack of instructional materials is a factor responsible for women's' backwardness in science literacy. Thus,Olagunji (2001), opened that allowing girls to participate in activity based learning will encourage their

performance. But these materials for teaching and learning science in Nigeria are very much in short supply, obsolete or nonfunctional and the only possible alternative is improvisation yet, information about their efficacy at enhancing learner attitude performance are scarce. This study investigates the impact on inquiry and demonstration methods on attitude retention and performance among physics students of varied abilitywill therefore fills the gap of gender difference in teaching and learning physics.

2.8 Overview of Similar Studies

Yusuf (2012) investigated the effects of integrating models with lecture method on academic Performance and retention of students of various class size in Biology. Aminu (2012) used a sample of 300 students. Six schools were used comprising of 25 students constituting small class – size, 50 students constituting average class size and 75 students constituting average class size was chosen respectively each for the experimental and control groups, which gives a total of 300 students. The experimental groups were taught using integrated instruction model, while the control groups were taught same concepts using lecture method. The finding from Yusuf (2012: 23) study shows that:

(a) There was significance difference in the academic achievement of students taught Biology concepts using integrated instructional models compared with their counterparts exposed to lecture method in small medium and large class sizes.

(b) There was significant difference in the retention ability of learned concepts using integrated models compared to their counterparts exposed to lecture method.

In this study the impact of inquiry and demonstration methods on attitude, retention and performance of physics students with varied abilities were investigated.

In a related study,Sarah (2011), Investigated the comparative effect of Inquiry and Expository Instructional Strategies on Achievement in Chemistry among concrete and formal operational secondary school students in Kaduna State, Nigeria. The sample consist one hundred and sixty six (166) students drawn from two secondary schools using random sampling technique in which pretest, posttest experimental design was used. A pretest using Chemistry Achievement Test and Group Assessment of Logical Thinking (GALT) was administered to two groups to determine their compatibility in ability level and reasoning ability before treatment. After treatment, CAT was administered as posttest to the two groups to ascertain the effect of the treatment. The data obtained were analyzed and six hypotheses stated were tested using t – test statistic at 0.05 level of significant. The Major findings of the study revealed that: Significant difference exist between the scores of students exposed to expository strategy and those exposed to inquiry strategy. Significant difference exists between performances of formal and concrete students exposed to inquiry instructional strategy with formal student performing significantly higher. Significant difference exists between formal and concrete students exposed to expository instructional strategy as formal students performed better. There is no significant difference between formal (male) and formal (female) students scores exposed to expository strategy as both group had almost equal performance. It was recommended that teachers should be trained on using inquiry method of teaching for concrete students to improve their performance in chemistry from the concrete reasoning to formal reasoning. In this study involvement of students using inquiry and demonstration methods were investigated.

Akeay, Durmaz, Tuysuz&Feyzioglu (2006), conducted a study which compared the effect of computer – based learning and traditional method on students' attitude toward analytical

chemistry at the DokuzEylul University's Chemistry Education Department. Students were randomly selected and grouped into three, comprising two experimental groups and a control group. Two different computer based methods which were analytical chemistry learning software (method A) and a Microsoft Excel program (Method B) were developed by the researchers and administered on the students. The control group was taught using the traditional method (Method C). The instruments used for the study were an attitude questionnaire and performance test related to analytical chemistry, these were applied to the three groups. A computer attitude test was also developed by the researcher and used to test students' attitude towards the computer. Significant differences were observed between the control group and both experimental groups, analytical chemistry performance in the experimental groups were also discovered to be significantly higher from the control group. In this study attitude of students' toward science education investigated.

In another study Gokhan, Alipasa andHulya (2004) investigated the effect of students performance of new teaching material developed for the unit 'acid and bases'. Also the students' attitudes towards physics were explored. The new materials included work sheets base on conceptual instructional method, the sample consisted of eighty – eight (88) students. The results from the post – test indicated that the students in the experimental group taught with the new teaching material showed significantly greater performance in the unit acids and bases than students in the control group. In addition the experimental groups had a significantly higher score than the control group, with regard to their attitude toward physics. This shows that the implementation of the new material produced better results both in terms of performance and attitude of student. Therefore this study

investigates whether the use of inquiry and demonstration as new methods, produce good performance and attitude in teaching and learning physics.

In a different study by Rasha, Wael and Francis (2007) found that a significant effect between the performance of male and female physics of senior secondary school (SSS) students' taught with Guide discovery, Demonstration and Expository Teaching Approaches. Akinbobola (2008), Afolabi and Akinbobola (2009) also shared similar view, when they found that in learning process involving reacting, doing and experiencing such as demonstration, information is better registered because the learner sees the instructors' demonstration. Bichi (2002) investigated the effect of problem – solving instructional strategy and historically enriched curriculum on Senior Secondary School students' Performance and retention of revolution concepts using the problem –solving instructional strategy performed significantly better than their counterparts in the control group who were taught the same evolution concepts using the traditional instructional method. Orji (1998) recommended that use of problem – solving and cognitive style to improve the physics students' performance. Therefore in this study involvement of students for inquiry and demonstration so as to enhance teaching and learning were investigated.

2.9 Implications of Literature Reviewed on the Present Study

This section deals with the implication of literature reviewed on the present study. Physics Secondary School Students' poor performance, attitude and retention is a matter of grave concern in Dawakin – Kudu Education Zone where students failure which attributed to poor teaching method used to teach students observed in Kano state physics SSII qualifying examination. Literature reviewed indicated that academic performance is strongly related to the teaching method and the ability of students to understand and retain fact as reviewed in

Bichi (2002) whoinvestigated the effect of problem – solving instructional strategy and historically enriched curriculum on Senior Secondary School students' Performance and retention of revolution concepts using the problem –solving instructional strategy performed significantly better than their counterparts in the control group who were taught the same evolution concepts using the traditional instructional method.An appropriate teaching method influence positively the performance and make easy retention of wave's concept and their connection. Literature also revealed many writings about Inquiry and demonstration methods.

In Kano State, Dawakin Kudu Education Zone in particular inquiry and demonstration methods has been conducted in its weak forms characterized by teachers and students in secondary schools within the zone. All the same these schools have found great benefits with weak form of inquiry and demonstration methods. This produces the need for design a study on strong form of inquiry and demonstration methods to investigate its impact on students' performance, attitude and retention with secondary school physics. In science teaching there is a serious controversy on gender issue. Therefore this study investigates the issue of gender difference on Performance, attitude and retention in physics using inquiry and demonstration methods because methodsenhance students' performance, and stimulate their interest to physic that is the method is learner friendly. Therefore, the single best supported finding in this research literature is the use of inquiry and demonstration methods as a supplement to traditional method, teacher directed instruction produce performance effects superior to those obtained with traditional instruction.

The findingsin this research literature hopefully facilitate a change in attitude of physics educators and students towards a more effective method of teaching such as the inquiry and

demonstration methods. Organizations engaged in scientific and technical activities for the national development, the teacher training institutions to incorporate the methods into their existing curricula and education planner and science curriculum planners to modify where necessary, the current science curriculum by incorporating the use of inquiry and demonstration methods in physics instruction.

Most of the researchers conducted painstaking variable such as academic performance, but based on the literature available the researchers, very little study was conducted previously on other variables such as gender, attitude retention, motivation, varied abilities and interest. This ushers the researcher with sight on choice of attitude, retention, gender and academic performance as variable of interest. Thus the study focuses on the impacts of Inquiry and Demonstration methods on attitude, retention and academic performance among physics students of varied abilities in Kano State, Nigeria. In science teaching, there is a serious controversy on gender issues. Therefore studyalso investigated the issue of gender difference on academic performance in physics using inquiry and demonstration methods and gender variable among students under the study.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study investigates the Impact of Inquiry and Demonstration Methods on Academic Performance, Retention and Attitude among secondary school Physics students of varied abilities in Kano, Nigeria. This chapter presents a general outline on the Methodology used in conducting the study. The chapter was presented under the following sub – headings:

- Research Design
- Population of the Study
- Sample and Sampling Techniques
- Concepts Scope for the Study
- Instrumentation
- Validity of the Instrument
- Pilot Testing
- Reliability of the Instrument
- Item Analysis
- Administration of Instrument
- Data Collection Procedure
- Procedure for Data Analysis

3.2 Research Design

This study employed pretest, posttest and Post - posttest quasi – experimental of equivalent control group design. The study used two groups; experimental and control. Experimental group (EG) is group exposed to Inquiry and Demonstration methods of teaching as a treatment (X_1), while control group (CG) taught wave concepts using lecture method (X_0). The two groups (experimental and control) pre – tested (O_1) on academic performance, attitude and retention to ensure that samples selected are not significantly different in terms of abilities of academic performance, attitude and retention before treatment. The two groups taught wave concepts for a period of five weeks. Then Post-test (O_2) administered to the groups in order to determine the impact of inquiry, demonstration and lecture methods of teaching on academic performance, attitude and retention on wave concepts of senior secondary two (II) physics students of varied abilities. The Postpost test (O_3) administered two (2) weeks later to all the groups in order to determined the level of the retention on wave concepts of senior secondary two (II) physics. The research design illustration of the study which has been recommended by Kiplinger (1973),Frankie andWillen (2000) is represented in Figure 1

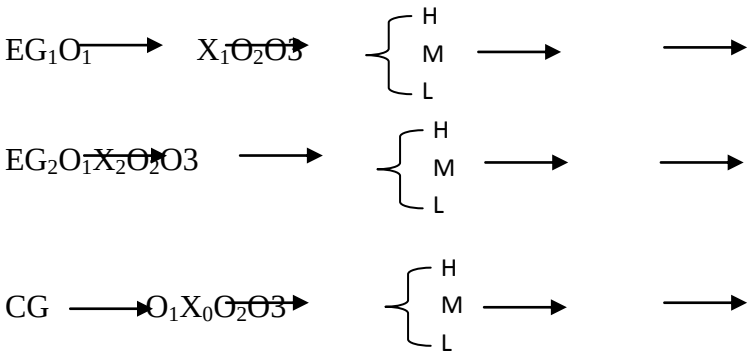


Fig1: Research Design.

Where:

EG_1 = Experimental Group 1 (Inquiry)

EG_2 = Experimental Group 2 (Demonstration)

CG = Control Group

X_1= Inquiry Method of Teaching

X_2= Demonstration Method of Teaching

X_0= Traditional Lecture Method of Teaching

O_1 = pre - test

O_2 = Post - test

O_3 = Postpost– test

H = High ability

M = Mediun ability

L = Low ability

3.3 Population of the Study

The target population used for this study is all Senior Secondary two (II) Physics Students of Dawakin – Kudu Education zone, Kano State, Nigeria. Based on the record from the Monitoring and Evaluation Division of Kano State Education Resource Department (2015), Dawakin – Kudu Education zone consists of thirty nine (39) public schools with the total number of five thousand eight hundred and nineteen (5819) for Senior Secondary two (II). All the (39) schools are single sex schools; the age range of the students is between 16 – 19 years. The detail of the list of the schools is given in Table 3.1

Table 3.1: Population of the Study

S/N	NAME OF SCSHOOL	TYPE OF SCHOOL	GENDER	SS2 PHYSICS ENROLMENT
1.	GASS DAWAKIN KUDU	Day	Male	145
2.	GSS GANO	Day	Male	162
3.	GGSS YARGAYA	Boarding	Female	265
4.	GSS WARAWA	Day	Male	95
5.	GSS DAWAKIJI	Day	Male	150
6.	GASSULUL ALBAB	Day	Male	90
7.	GGSS KUMBOTSO	Day	Fe Male	54
8.	GGSS GANO	Day	Male	43
9.	GSS MARIRI	Day	Male	314
10.	GSS NAIBAWA	Day	Male	354
11.	GSS PANSHEKARA	Day	Male	312
12.	GSS SHEKAR BARDE	Day	Male	501
13.	GGSS DAWAKIN KUDU	Day	Female	92
14.	GSS TAMBURAWA	Day	Male	118
15.	GSSTANAGAR	Day	Male	93
16.	GSS YANKATSARE	Day	Male	107
17.	GSS YARGAYA	Day	Male	186
18.	SES TUDUN MALIKI	Boarding	Male	96
19.	GSS GOGEL	Day	Male	60
20.	GSS JAOJI	Day	Male	178
21.	GGSS CHIRANCI	Day	Female	364
22.	GGASS SHEKA	Day	Male	358
23.	GSS DAWAKIN KUDU	Day	Male	151
24.	GSS DANMALIKI	Day	Male	151
25.	GSS CHALAWA	Day	Male	30
26.	GGSS WAILARI	Day	Female	237
27.	GGSS ABDU MARIRI	Day	Female	206
28.	GGASS PANSHEKARA	Day	Female	198
29.	SRCOE STAFF SCHOOL	Day	Male	46
30.	GSS KAYI PANSHEKARA	Day	Male	156
31.	GSS DANBARE	Day	Male	83
32.	ABBAS KHALIFACOLLEGE	Day	Male	60
33.	GGSS MEDULE	Day	Female	69
34.	GSS GARINDAU	Day	Male	43
35.	GGASS JIDO	Day	Female	32
36.	GGSS ASSYYADA ZAINAB	Day	Male	44
37.	GSS TSAKUWA	Day	Male	70
38.	GGSS ZAWACIKI	Day	Female	51
39.	GGSS GURINGAWA	Day	Female	64
	Grand Total			**5819**

Source: Monitoring and Evaluation Division of Kano State Education Resource Department (2015)

3.4 Sample and Sampling Techniques

The stratified sampling techniques used as sampling technique where three girls and three boys' schools used as sample. This makes a total number of six schools drawn from the thirty nine (39) secondary schools. Sixintact classes (Experimental and Control, that is,fourtreatment and two control groups) used and physics students randomly pick up by ballotingfor each class. The totalof physics students from six schools are five hundred (500) representing the sample of the study. The students randomly assigned in to two groups (Experimental that is fourtreatment and two control groups). The treatment groups taught on the Wave Concepts using the sensitized Inquiry and Demonstration methods of teaching while the conventional method (lecture) used for the control group. The selected schools used in this study as samples are given in Table 3.2.

Table 3.2: Sample of the Study

S/N	NAME OF SCHOOL&	GANDER	GROUP	NO. OF SAMPLE	TOTAL
1.	GGSS YARGAYA	Female	Experimental(Inquiry)	90	90
2.	GSS DAWAKIN KUDU	Male	Experimental(Inquiry)	60	60
3.	GGSS WAILARI	Female	Experimental(Demonstration)	80	80
4.	GSS NAIBAWA	Male	Experimental(Demonstration)	70	70
5.	GSS SHEKAR BARDE	Male	Control	100	100
6.	GGSS ABDU MARIRI	Female	Control	100	100
	Total				**500**

3.5 Concepts Used for the Study

The waves concept is selected to draw the content for the treatment and as well guided the design of the instrument that used to measure the students' academic performance, attitude and retention in physics because the concepts selected specifically placed in secondary school II physics syllabus and the course description approved by National Educational Resource Development Centre (NERDC) 2013 revised edition also used to select the topics. The concepts are: Production & propagation of waves, Type of waves, Properties of waves, Light & Sound waves.

3.6 Instrumentation

The instruments used for this study are taggedPhysics Performance Test (PPT) and Waves Concept Attitude Scale Questionnaire (WCASQ) which developed by the researcher.

3.6.1 The Physics Performance Test (PPT)

PPT consisting of fifty (50) multiple objective test items each to determine the Retention and Academic Performance of the students in Wave Concepts of secondary schools two (SS II) physics syllabus. The PPT test was pilot – test using a school that is not included in the study but similar characteristic as a sample school is to ascertain the test reliability of the using Pearson's Product Moment Coefficient (PPMC) formula. The contents to be used in the class instruction were developed based on the revised Nigeria Educational Research Development Center (NERDC) physics syllabus. The PPT test item with the marking scheme were validated by specialist from science education ABU and six physics teacher from six schools selected for the studyandPPT constructed based on the Table of Specification (test blue

Table 3.3: Specification Based on Blooms Taxonomy

S/N	Content	Weight (%)	Knowledge (25)	Comprehensive (23)	Application (15)	Analysis (13)	Synthesis (12)	Evaluation (12)	Total 100
1	Production	18	2	1	1	2	1	1	8

	&propagation of waves								
2	Types of waves	20	3	2	1	1	1	1	9
3	Properties of waves	22	4	3	1	1	2	1	12
4	Light waves	20	3	2	2	2	1	1	11
5	Sound waves	20	2	2	3	1	1	1	10
	Total	100	14	10	8	7	6	5	50

Source: Adapted from: Obeka (2012)

3.6.2 Waves Concept Attitude Scale Questionnaire (WCASQ)

The Waves Concept Attitude Scale Questionnaire (WCASQ) is an instrument developed by the researcher to determine the attitude of students to Wave Concepts using Experimental and Control Groups, and the purpose of this instrument was determine whether students have favorable or unfavorable attitude towards the use of the inquiry and demonstration methods as well as the conventional method. WCASQ is constructed based on recommendation of likert type that is five point scales: Strongly Agree (A), Agree (A), Undecided (UD), Disagree (D) and Strongly Disagree (SD).The detail of questionnaire is in Appendix vi. The attitude of the questionnaire was administered to the experimental groups before and after instruction in order to determine the change in the attitude of the students towards physics concepts taught. The instrument was validated by specialist in the field of science education, psychology and language. Their suggestions lead to the reframing and elimination of ambiguous and inappropriate statements. The 30 items on the questionnaire were presented for face validation.

3.7 Validity of the Instrument

The instrument validated by experts in science education who are PhD holder and with minimum rank of senior lecturer in the Faculty of Education, Department of science education, Ahmadu Bello University Zaria and six Senior Secondary Schools selected for the study. They were requested to study the instrument and clarify if the questions are considered to be testing where they meant to test, examine whether the items are clear to avoid ambiguity, certify if the questions are appropriate for the level of the students under the study and check for possible errors in the instrument and suggested the corrections.

3.8 Pilot Study

The pilot study conducted with a group of fifty (50) students in one of senior secondary schools which was not part of the study sample but part of the population, to determine the reliability of the instruments. The school selected for this purpose is similar to those schools of the main study in term of location, ownership and status level. PPT was administered to these students using test – retest method with an interval of weeks. WCASQ was also pilot tested at the same school and split half method was used to test the reliability of score on fifty (50) students. The scores were split in to equivalent halves arranged as odd and even numbered items. The score of the two halves were correlated and Spearmen Rank Order Correlation Statistics was used to estimate the reliability of the instrument. The purposes of this pilot study are to:

- Get reliability coefficient of the instruments
- Determine the appropriateness of the items of the instruments
- Identify the appropriate statistical tools that can be used in the main study.
- Established appropriate timing for the instruments
- Establish the characteristics of the instruments

3.9 Reliability of the (PPT) Instrument

The test – retest method using Pearson Product Moment Correlation Coefficient statistics used to determine the reliability of the PPT. Some test is administered on two different occasions at two weeks interval as recommended by Tuckman (1975). The score from the two administrations correlated as an estimate of the reliability of the test (Sambo, 2005). The reliability of the PPT after correlation is 0.90, which show the instrument is reliable and be used for data collection in this study. Summary of the analysis are in the Appendix x

3.9.1Reliability of the (WCASQ) Instrument

Todetermine the reliability of WCASQ, theGuttman Split – Half Coefficient formula used to obtain the reliability co –efficient of WCASQ and the resultant t was found to be 0.97, showing that the instrument is reliable and be used for data collection in this study. Summary of the analysis are in the Appendix xi

3.10 Items Analysis

The result of the pilot study conducted was used to determine the item analysis of physics performance test (PPT). The analysis was based on the item difficulty and discrimination indices. Item difficulty is a measure of percentage of candidates who got the item right divided by the total number of candidates that attempted the item. The discrimination index of the test is the ability of the test item to separate between high and lo – ranking students in the entire test (NTI, 2009).

The item difficulty is determined using the relation: P = R / T X 100

Where: P = item difficulty

R= number of candidates who the item right

T= is the total number of candidates

Researchers such as Tuckman (1975) and Sambo (2008),suggested that items with difficulty index between 40% to 60% are accepted as good item. Item below 40% are considered being too easy, and 60% being too difficult. For the purpose of this study, items with difficulty index of 30% to 75% are retained while others are modified to suite the research. The discrimination index of the test is determined using the relation:

D = RU – RL / N

Where: D = discrimination index of test item

RU = number of candidates that got the item correct in the upper 27% of the group

RL = number of candidates that got the item correct in the lower 27% of the group

N = number of candidates in the 27% upper or lower of the group

Sambo (2008), suggested that items of discrimination index of 0.30 – 0.90 are very good for the study, 0.30 – 0.39 are reasonable good, 0.20 – 0.29 are marginal items that need to be improvement while items with discrimination index of 0.1 – 0.19 are poor items to be discarded. Thus in this study item between 0.30 – 0.70 was accepted for final selecting of PPT instrument.Summary of the analysis are in the Appendix vii

3.11 Administration of Treatment

During the administration of treatment, the Experimental Group taught wave concepts using Inquiry and Demonstration methods while the Control Group taught using Lecture method.

3.11.1 Administrating instruments to the Experimental GroupOne (Inquiry)

The students in theExperimental Group One taught Production& propagation of waves, Type of waves, Properties of waves, Light waves and Sound waves using Inquiry methodby the researcher. Production& propagation of waves presented as Lesson one (1) and taught in the first week, Type of waves presented as Lesson two (2) and taught in the second week, Properties of waves presented as Lesson three (3) and taught in the third week, Light wavespresented as Lesson four (4) and taught in the fourth week and Sound waves presented as Lesson five (5) and taught in the fifth week respectively. The lessons presentation is based on the following steps;

Step1: - Define wave

- Identify waves and types of waves
- Propagation of waves
- Presentation of waves

Step2: Students activities using Inquiry method

- Students were able to observed the propagation and production of waves
- Identify the types of waves
- Draw the presentation of wave either sound and light waves
- Carry out calculation and measurement on parameter of waves

Step3: Discussion by students based on the observation and finding about wave concepts

Step4: Evaluation where by students and teacher response to students question based on the findings and discussion by students such as follows:

- Define waves
- Mention Type of wave s
- Identify difference between light and sound wave

The lessons were guided using the flow chart below and lesson plans in appendix iii respectively.

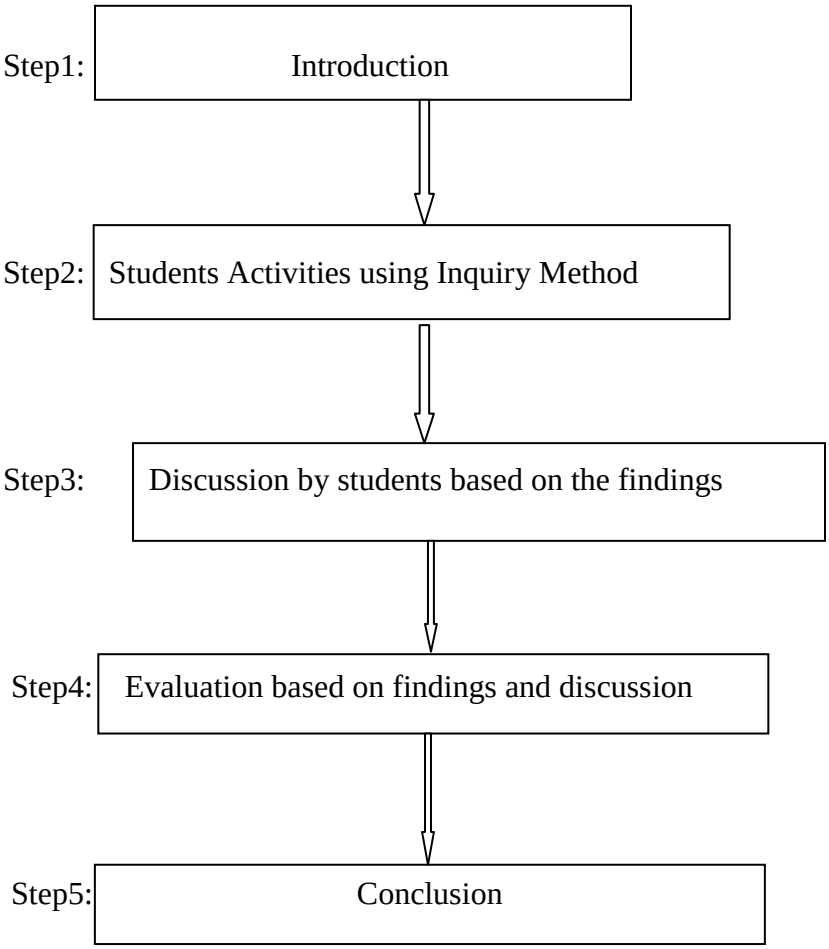


Figure 3.1: Flow chart on lesson for Experimental Group I (Inquiry)

Source: Adopted from Ikpe (2014)

3.10.1 Administrating instruments to the Experimental Group Two (Demonstration)

The students in theExperimental Group Two taught Production& propagation of waves, Type of waves, Properties of waves, Light waves and Sound waves using Demonstration method by the researcher. Production& propagation of waves presented as Lesson one (1) and taught in the first week, Type of waves presented as Lesson two (2) and taught in the

second week, Properties of waves presented as Lesson three (3) and taught in the third week, Light waves presented as Lesson four (4) and taught in the fourth week and Sound waves presented as Lesson five (5) and taught in the fifth week respectively. The lessons presentation is based on the following steps;

Step1: - Define wave

- Identify waves and types of waves
- Propagation of waves
- Draw the Presentation of waves

Step2: Students activities using Demonstration method

- Teacher and Students were able to exhibit how waves propagated and produced by showing the example using the concepts of physics under study
- Students were to identify the types of waves using demonstration of wave motion process
- Students to draw the presentation of wave either using sound and light waves
- Students to carry out calculation and measurement the parameter of wave concepts of physics

Step3: Discussion on students finding based on the observation during demonstration of wave concepts of physics

Step4: Evaluation where by students and teacher response to students question based on the findings and discussion of the exhibitionby students such as follows:

- Define waves
- Mention Type of waves
- List three parameter of waves

- Draw the presentation of wave either using sound and light waves

The lessons were guided using the flow chart below and lesson plans in appendix iv respectively.

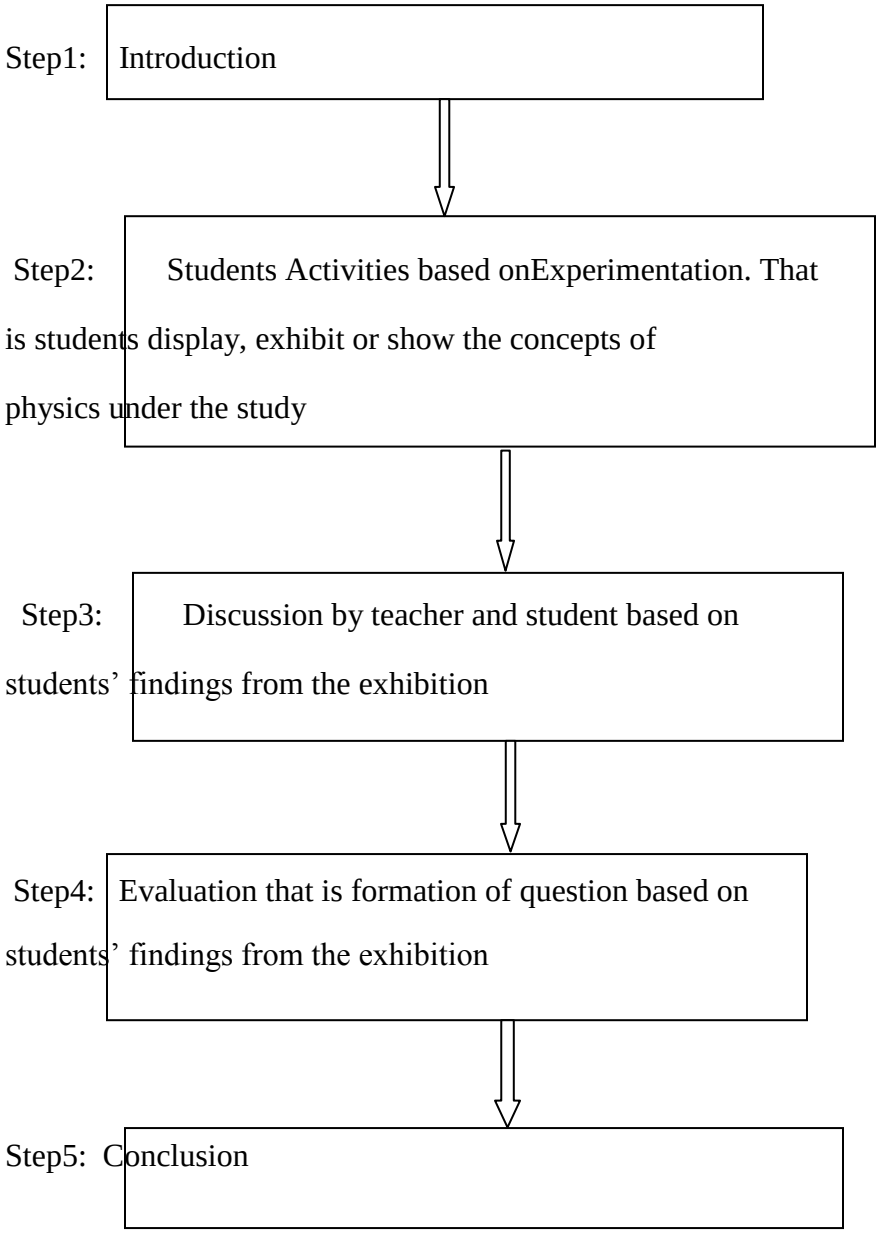


Figure 3.2: Flow chart on lesson for Experimental Group II (Demonstration method)

Source: Adopted from Ikpe (2014)

3.10.3 Administrating instrument to the Control Group (Lecture)

The control group was taught the same wave concepts of physics by using conventional teaching method for the period of five weeks. The teaching note prepared by the researcher and presented week by week that is students in the Control Group lecture method taught Production and propagation of waves, Type of waves, Properties of waves, Light waves and Sound waves using Lecture method by the researcher. Production& propagation of wave presented as Lesson one (1) and taught in the first week, Type of waves presented as Lesson two (2) and taught in the second week, Properties of waves presented as Lesson three (3) and taught in the third week, Light waves presented as Lesson four (4) and taught in the fourth week and Sound wavespresented as Lesson five (5) and taught in the fifth week respectively.The lessons were guided using lesson plans in appendix v respectively. Notes were given to the subjects after each teaching period and subjects were referred to relevant physics textbooks for more information. The physics attitude questionnaire was administered to the control groups before after five weeks of teaching. The posttest was administered to the groups a week after the last lessons.

The same test was administered as post – posttest, after two weeks from the data of the last test. The physics attitude questionnaire was administered after five weeks of teaching. The different scores obtained during protest and post – posttest were used for data analysis

3.11. Data Collection Procedure

The Physics Performance Test (PPT) data was obtained from the pre – test, post – test and post – post test academic performance test administered to the Senior Secondary Two Physics students of varied abilities in the experimental and control groups. The students' attitude toward wave concepts questionnaire (WCASQ) data was obtained from the pre –

test, post test attitude questionnaire administered to the Senior Secondary Two Physics students of varied abilities in the experimental and control groups.

3.12 Data Analysis

The followings are the research questions answerat 0.05 the level of significant difference.

i. What is the difference in the mean score of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method only?

   The research question 1 were answered using Mean, Standard Deviation and Mean Difference

ii. What is the difference in retention ability when students are taught Waves Concept of physics using Inquiry, Demonstration and Lecture methods of teaching?

   The research question 2 were answered using Mean, Standard Deviation and Mean Difference

iii. What is the difference in change of attitude when students are taught wave concepts using Inquiry, Demonstration and Lecture methods of teaching?

   The research question 3 were answered using Mean, Standard Deviation and Mean Difference

iv. What is the gender difference when students are taught Waves Concept using Inquiry, Demonstration and Lecture methods of teaching?

   The research question 4 were answered using Mean, Standard Deviation and Mean Difference

v. What is the difference in varied abilities when students taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching?

The research question 5 were answered using Mean, Standard Deviation and Mean Difference

vi. What is the difference in academic performance between rural and urban Senior Secondary Two Physics students taught wave concepts using Inquiry, Demonstration and Lecture methods of teaching?

The research question 6 were answered using Mean, Standard Deviation and Mean Difference

Null Hypotheses

The following Null hypotheses were tested at $P \leq 0.05$ levels of significance:

Ho_1: There is no significant difference in the mean score of students taught Wave Concepts using Inquiry, Demonstration methods of teaching and there counterparts taught with the traditional lecture method only.

The null hypothesis one was tested using Analysis of Variance (ANOVA)

Ho_2: There is no significant difference in retention ability of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method.

The null hypothesis two wasanalyzed using Analysis of Variance (ANOVA)

Ho_3: There is no significant difference in change of attitude when students are taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

The null hypothesis three wasanalyzed using Analysis of Variance (ANOVA) and Kruskalwallis Test

Ho_4: There is no significant gender difference among the academic performances mean scores of students taught Wave Concepts using Inquiry and Demonstration methods and those taught with the traditional lecture method only.

The null hypothesis four wasanalyzed using Analysis of Variance (ANOVA)

H_{O5}: There is nosignificant difference in varied abilities when students taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

The null hypothesis five wasanalyzed using Analysis of Variance (ANOVA)

H_{O6}: There is no significant difference in the academic mean scores between rural and urban Senior Secondary Two Physics students taught waves concept using Inquiry, Demonstration and Lecture methods of teaching.

The null hypothesis six wasanalyzed using Analysis of Variance (ANOVA).

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This study investigates the impact of inquiry and demonstration methods on attitude, retention and performance among secondary school physics students of varied abilities in Kano; Nigeria. The analysis and results of the data collected and their discussions are presented in this chapter. The data collected were analyzed using the Statistical Package for Social Science (SPSS) version 16 and the level of significance adopted for rejecting or retaining, the stated hypotheses was 0.05. The chapter also contains discussion of the results and summary of the findings from the results presented.

The pretest data were used to establish the equivalence of the two groups before the experiment. To achieve this, the pretest mean scores of the experimental and control groups were subjected to ANOVA statistic. The result shows no significant difference between the mean scores. This implies that the group shows equivalence with respect to their knowledge of physics concepts.Summary of ANOVA analysis for the pre test are shown in the Appendix xiii at the end of the report.

4.2 Data Analysis and Results.

Research Question1: What is the difference in the mean score of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method only?

To answer question one, a descriptive statistics of mean and standard deviation were used.

Table 4.1a. Means and Standard Deviations of Posttest Scores for the Experimental Group (EG) and Control Group (CG)

Scores

Teaching Methods	N	Mean	Std. Deviation	Mean Difference (EG-CG)
Inquiry	150	60.4133	10.34777	
				17.14333*
Lecture	100	43.2700	11.02063	
Total	250	103.6833	21.3684	

Table 4.1a showed that the mean scores of the Experimental Group (EG1) that is taught using Inquiry methods were 60.41 with standard deviation of 10.35 while the Control Group (CG) that is taught using lecture method has 43.27 with standard deviation of 11.02. It clear from the figures in Table 4.1a, that the Experimental Group1 exposed to inquiry method performed better than their counter part exposed to lecture method.

Table 4.1b. Means and Standard Deviations of Posttest Scores for the Experimental Groups (EG) and Control Groups (CG)

Teaching Methods	N	Mean	Std. Deviation	Mean Difference (EG-CG)
Demonstration	150	59.2600	11.90760	
				17.14333*
Lecture	100	43.2700	11.02063	
Total	250	102.53	22.92823	

Table 4.1ab showedthat the mean scores of the Experimental Group (EG2) that is taught using demonstration method were 59.26 with standard deviation of 11.91 while the Control

Group (CG) that is taught using lecture method has 43.27 with standard deviation of 11.02. It clear from the figures above that the Experimental Group2 exposed to demonstration method performed better than their counter part exposed to lecture method.

Null Hypothesis 1 (H_O1): There is no significant difference in the mean score of students taught Wave Concepts using Inquiry, Demonstration methods of teaching and their counterparts taught with the traditional lecture method only.

To test Null Hypothesis one, ANOVA Results of Posttest Mean Scores for the Experimental Groups (EGs) and Control Group (CG)were used. The detail of the results is presented in Table 4.1c

Table 4.1cANOVA Results of Posttest Mean Scores for the Experimental Group (EGs) and Control Group (CG)

Scores

Groups	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	33034.297	2	16517.148	134.023	.001	Significant
Within Groups	61250.653	497	123.241			
Total	94284.950	499				

*. The mean difference is significant at the 0.05 level.

Analysis from the Table 4.1b, indicated that the calculated F – value is 134. 023 with the degree of freedom Between Groups and Within Groups 2 and 497, degree of freedom total is 499. This value is greater than F – crtl at alpha = 0.05 level of significance. It show that there is significant differences between the post test scores of the EG that is Inquiry, Demonstration methods and CG that is lecture method. Therefore, the hypothesis is

rejected and accepted the altrahypothsis. Moreover the P – value is 0.001. This indicates a significant difference in the performance of the three groups at alpha value of 0.05 with total degree of freedom df_t = 499. This means that there is significant difference between the post test score of the experimental and the control group in favour of the experimental groups. That is, Inquiry and Demonstration methods. Thus the hypothesis is rejected. This implies that the experimental group taught the wave concepts using Inquiry and Demonstration methods achieved significantly higher than the control group taught the same concepts using lecture method.

Table 4.1d Scheffe Test Results of Posttest Mean Scores for the Experimental Groups (EGs) and Control Group (CG)

(I) teaching method	(J) teaching method	Mean Difference (I-J)	Std. Error	Sig.	Remark
Demonstration	Inquiry	-1.15333	1.28188	.667	NS
	Lecture	15.99000*	1.19909	.00	S
Inquiry	Demonstration	1.15333	1.28188	.667	NS
	Lecture	17.14333*	1.19909	.00	S
Lecture	Demonstration	-15.99000*	1.19909	.00	S
	Inquiry	-17.14333*	1.19909	.00	S

*. The mean difference is significant at the 0.05 level.

It can be seen from post hoc testin Table 4.1cthat the mean scores difference of the two Experimental Groups (EGs) that is Inquiry and Demonstration methods was 1.153 and – 1.153 with the significant level of .667 while the Control Group (CG). That is lecture method has 17.143 with the significant level of .00 It clear from the figures above that the

Experimental Groups exposed to Inquiry and Demonstration teaching methods performed better than their counterparts exposed to lecture method.

Research Question2: What is the difference in retention ability when students taught Wave Concepts of physics using Inquiry, Demonstration and Lecture methods of teaching?

To answer question two, a descriptive statistics of mean and standard deviation were used. The detail of the results is presented in Table 4.2a

Table 4.2a Means and Standard Deviations of Post - posttest Mean Scores of the Experimental Groups (EGs) and Control Group (CG)

Retention

Teaching Methods	N	Mean	Std Deviation	Mean Difference (EG-CG)
Inquiry	150	50.8267	12.35099	5.14667*
Lecture	100	45.6800	10.42502	
Total	250	96.5067	22.77601	

From Table 4.2a, the results showedthat the post posttest mean scores of the two Experimental Group one (EG1), that is, Inquirymethods was 50.83 with standard deviation of 12.35 while the Control Group (CG) That is, lecture method has 45.68 with standard deviation of 10.43. It clear from the results in Table 4.2a showed that the Experimental Group oneexposed to Inquiry method retained better than their counterparts exposed to lecture method.

Table 4.2b Means and Standard Deviations of Post - posttest Mean Scores of the Experimental Groups (EGs) and Control Group (CG)

Teaching Methods	N	Mean	Std. Deviation	Mean Difference (EG-CG)
Demonstration	150	49.2933	12.81596	5.14667*
Lecture	100	45.6800	10.42502	
Total	250	94.9733	23.24098	

From Table 4.2b, the results showedthat the post posttest mean scores of the Experimental Groups two (EG2), that is, Demonstration methods was 49.29 with standard deviation of 12.82while the Control Group (CG) That is, lecture method has 45.68 with standard deviation of 10.43 respectively. It clear from the results in Table 4.2b showed that the Experimental Group two exposed to Demonstration method retained higher than their counterparts exposed to lecture method.

NullHypothesis 2 (H_O2): There is no significant difference in retention ability of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method.

To test Null Hypothesis two, ANOVA Results of Post -Posttest Mean Scores of the Experimental Groups (EGs) and Control Group (CG)were used. The detail of the results is presented in Table 4.2c

Table 4.2cANOVA Results of Post-posttest Mean Scores for the Experimental Groups (EGs) and Control Group (CG)

Retention Test

Groups	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	2478.461	2	1239.231			
				8.948	.001	Sig.
Within Groups	68830.107	497	138.491			
Total	71308.568	499				

*. The mean difference is significant at the 0.05 level

Analysis from the Table 4.2c, indicated that the calculated F – value is 8. 948 with the degree of freedom Between Groups and Within Groups 2 and 497, degree of freedom total is 499. This value is greater than F – critical at alpha = 0.05 level of significance.It shows that there is significant difference between the postpost test scores of the EG that is Inquiry, Demonstration methods and CG that is lecture method. Therefore, the hypothesis is rejected. Moreover the P – value is 0.01. This indicates a significant difference in the retention of the three groups at alpha value of 0.05 with total degree of freedom $df_t = 499$. This means that there is significant difference between the postpost test score of the experimental and the control group in favour of the experimental groups that is Inquiry and Demonstration methods. Thus, the hypothesis is rejected. This implies that the experimental group taught the wave concepts using Inquiry and Demonstration methods of teaching retained significantly higher than the control group taught the same concepts using lecture method.

Table 4.2dSheffe Test Results of Post - posttest Mean Scores for the Experimental Groups (EGs) and Control Group (CG)

(I) teaching method	(J) teaching method	Mean Difference (I-J)	Std. Error	Sig.	Remark
Demonstration	Inquiry	-1.53333	1.35888	.530	Sig.
	Lecture	3.61333*	1.27111	.018	Sig
Inquiry	Demonstration	1.53333	1.35888	.530	Sig
	Lecture	5.14667*	1.27111	.000	Sig
Lecture	Demonstration	-3.61333*	1.27111	.018	Sig
	Inquiry	-5.14667*	1.27111	.000	Sig

*. The mean difference is significant at the 0.05 level.

From the post hoc test in Table 4.2d, it shows that the post posttest mean scores difference of the two Experimental Groups (EGs) that is, Inquiry and Demonstration methods was 1.533 and – 1.533 respectively with the significant level of .530 while the Control Group (CG) That is, lecture method has 5.146 with the significant level of .00. It is clear from the figures above that the Experimental Groups exposed to Inquiry and Demonstration teaching methods retained better than their counter part exposed to lecture method.

Research Question3: What is the difference in change of attitude when students are taught wave concepts using Inquiry, Demonstration and Lecture methods of teaching?

To answer question three, a descriptive statistics of mean and standard deviation were used. The detail of the results is presented in Table 4.3a

Table 4.3a Means and Standard Deviations ofChange of Attitude Mean Scores of the Experimental Groups (EGs) andControl Group (CG).

Attitude of Students

Teaching Methods	N	Mean	Std. Deviation	Std. Error	MeanDifference (EG – CG)
Inquiry	150	3.6201	.33699	.02751	.73872*
Lecture	100	2.8814	.34568	.02444	
Total	250	6.5015	0.68267	0.05195	

From the Table 4.3a, it showsthat the change of attitude mean scores of the Experimental Group one (EG1) that is, Inquiry teaching method was 3.62 with standard deviation of .337 while the Control Group (CG). That is, lecture method has mean score of 2.88 with standard deviation of .346. Therefore, from the Table 4.3a the Experimental Group one exposed to Inquiry method change higher in attitude than their counterparts exposed to lecture method.

Table 4.3a Means and Standard Deviations of Change of Attitude Mean Scores of the Experimental Groups (EGs) and Control Group (CG).

Attitude of Students

Teaching Methods	N	Mean	Std. Deviation	Std. Error	MeanDifference (EG – CG)
Demonstration	150	3.0464	.41025	.03350	.73872*
Lecture	100	2.8814	.34568	.02444	
Total	250	3.1525	.47999	.02147	

From the Table 4.3a, it showsthat the change of attitude mean scores of the Experimental Group two (EG2) that is, Demonstration teaching method was 3.04 with standard deviation of .410 while the Control Group (CG). That is, lecture method has mean score of 2.88 with standard deviation of .346 respectively. Therefore, from the Table 4.3b the Experimental Group two exposed to Demonstration method change better in attitude than their counterparts exposed to lecture method.

NullHypothesis 3 (H_O3): There is no significant difference in change of attitude when students are taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

To test Null Hypothesis three, ANOVA Results of Change of Attitude Mean Scores of the Experimental Groups (EGs) and Control Group (CG)were used. The detail of the results is presented in Table 4.3b

Table 4.3cANOVA Results of Change of Attitude Mean Scores for the Experimental Groups (EGs) and Control Group (CG)

Attitute of students

Groups	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	49.186	2	24.593			
				185.819	.001	Sig
Within Groups	65.777	497	.132			
Total	114.963	499				

*. The mean difference is significant at the 0.05 level

Analysis from the Table 4.3c indicates that the calculated F – value is 185. 82 with the degree of freedom Between Groups and Within Groups 2 and 497, degree of freedom total

is 499. This value is greater than F – critical .001 at alpha = 0.05 level of significance. It shows that there is significant differences in change of attitude between the scores of the EG and CG that is Inquiry, Demonstration methods and lecture method. Thus the null hypothesis is rejected. The P – value is 0.001. Therefore is a significant difference in the change of attitude of the three groups at alpha value of 0.05 with total degree of freedom df_t = 499. This means that there is significant difference in change of attitude between the score of the experimental and the control group in favour of the experimental groups. Thus the null hypothesis is rejected. This implies that the experimental group taught the wave concepts using Inquiry and Demonstration methods significantly change higher attitude than the control group taught the same concepts using lecture method.

Table 4.3dScheffe Test Results for Change of Attitude Mean Scores of the Experimental Groups (EGs) and Control Group (CG)

(I) Teaching Method	(J) Teaching Method	Mean Difference (I-J)	Std. Error	Sig.	Remark
Demonstration	Inquiry	-.57367*	.04201	.001	Sig.
	Lecture	.16505*	.03929	.001	Sig
Inquiry	Demonstration	.57367*	.04201	.001	Sig
	Lecture	.73872*	.03929	.001	Sig
Lecture	Demonstration	-.16505*	.03929	.001	. Sig
	Inquiry	-.73872*	.03929	.001	Sig

From post hoc test in Table 4.3d, it shows that the changes in attitude mean score difference of the two Experimental Group (EGs) that is, Inquiry and Demonstration methods was .574 and – .574 respectively with the significant level of .001 while the Control Group (CG), that is lecture method has .739 with the significant level of .001. Therefore, from Table 4.3dthe results shows that the Experimental Groups exposed to Inquiry and Demonstration methods of teaching change better in attitude than their counterparts exposed to lecture method.

Table 4.3eKruskalwallis Test of Change of Attitude Mean Ranks Before and After of the Experimental Groups (EGs) and Control Group (CG)

Method	Group	N	Mean Rank	Mean	S. D	X^2	Df	p-value	Remark
Inquiry	Before	150	75.50	1.5010	1.33315	247.629	1	.001	Sig
	After	150	225.50						
Demonstration	Before	150	75.50	1.6100	1.43269	254.803	1	.001	Sig
	After	150	225.50						
Lecture	Before	200	100.50	1.8448	1.66453	329.747	1	.001	Sig
	After	200	300.50						

The result in Table 4.3e shows that there is significant differences in change of attitude between the scores before mean rank of 75.50 and 75.50, after with mean rank of 225.50 and 100.50 of the (EGs) that is Inquiry, Demonstration methods while(CG) that is lecture method with the scores before mean rank of 100.50 and after with mean rank of 300.50. The standard deviation and chi square of (EGs) are 1.33 and 1.43 then chi square of 247.6 and 254.8 of the (EGs) while (CG) that is lecture method withstandard deviation and chi square of 1.66 and 329.7 respectively. Kruskalwallisof .001 at level of significant. Thus the hypothesis is rejected. Moreover the P – value is 0.01. This indicates a significant difference in the change of attitude of the three groups using before treatment and after treatment Thus the hypothesis is rejected. This implies that the experimental group taught the wave concepts using Inquiry and Demonstration methods significantly change higher attitude than the control group taught the same concept using lecture method after the treatment.

Research Question4: What is the gender difference when students taught Waves Concept using Inquiry, Demonstration and Lecture methods of teaching?

To answer question four, a descriptive statistics of mean and standard deviation were used. The detail of the results is presented in Table 4.4a

Table 4.4a Means and Standard Deviations of the Posttest Mean Scores Gender Difference ofExperimental Groups (EGs) and Control Group (CG).

Teaching Methods	Gender	N	Mean	Std. Deviation	Mean Difference (M – F)
Lecture	Male	100	43.1400	11.29675	
					7.97000*
	Female	100	43.4000	10.79281	
	Total	200	43.2700	11.02063	
Inquiry	Male	60	35.6200	30.28577	
					11.60000*
	Female	90	55.0000	20.89802	
	Total	150	45.3100	27.71180	

The result in Table 4.4a shows that experimental group one that is inquiry method has mean for male and female of 35.6200 and55.0000 respectively and standard deviation of 30.28577 and 20.89802 for male and female while control group (CG) has the mean of 43.14 and standard deviation of 11.30 and 10.79 for male and female from the Table 4.4a showed that experimental group one expose to inquiry methodperformed higher than the control group (CG) based on gender.

Table 4.4bMeans and Standard Deviations of the Posttest Mean Scores Gender Difference of Experimental Groups (EGs) and Control Group (CG).

Teaching Methods	Gender	N	Mean	Std. Deviation	Mean Difference (M – F)
Lecture	Male	100	43.1400	11.29675	
					7.97000*
	Female	100	43.4000	10.79281	
	Total	200	43.2700	11.02063	
Demonstration	Male	70	41.8600	29.29371	
					6.24000
	Female	80	47.0300	25.92275	
	Total	150	44.4450	27.71149	

The result in Table 4.4b shows that experimental group one that is inquiry method has mean of 41.8600 and 47.0300and standard deviation of 29.29371 and 25.92275 for male and female respectively while control group (CG) has the mean of 43.14 and standard deviation of 11.29675 and 10.79281 for male and female from the Table 4.4b showed that experimental group one expose to demonstration method performed higher than the control group (CG) based on gender.

NullHypothesis 4(H_O4):There is no significant gender difference among the academic performances means scores of students taught Wave Concepts using Inquiry and Demonstration methods and those taught with the traditional lecture method only.

To test Null Hypothesis four, ANOVA Results of Gender Differences Mean Scores of the Experimental Groups (EGs) and Control Group (CG)were used. The detail of the results is presented in Table 4.4c

Table 4.4cANOVA Results of Gender Differences Mean Scores of the Experimental Groups (EGs) and Control Group (CG).

Gender

Groups	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	.867	2	.433			
				1.746	.176	Not Sig.
Within Groups	123.333	497	.248			
Total	124.200	499				

*. The mean difference is significant at the 0.05 level.

From the result in Table 4.4c, it implies that in all ramifications female perform better compared to the male students. Furthermore, Analysis from the Table 4.4b, indicated that the calculated F – value is 1. 746 with the degree of freedom Between Groups and Within Groups 2 and 497, degree of freedom total is 499. This value is greater than F – critical at alpha = 0.05 level of significance, it shows that this means there is significant gender differences between the post test scores of the EG and CG that is Inquiry, Demonstration methods and lecture method. Thus the hypothesis is rejected. Moreover the P – value is 0.176. This indicates a significant difference in the gender of the three groups at alpha value of 0.05 with total degree of freedom $df_t = 499$. This means that there is no significant gender difference between the post test score of the experimental and the control group in favour of the female in the experimental groups, that is, Inquiry and Demonstration methods. Thus the hypothesis is accepted. This implies that the experimental group taught

the wave concepts using Inquiry and Demonstration methods significantlyfavour gender higher than the control group taught the same concept using lecture method.

Research Question5: What is the difference in varied abilities when students taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching?

To answer question five, a descriptive statistics of mean and standard deviation were used. The detail of the results is presented in Table 4.5a

Table 4.5a Means and Standard Deviations of the Posttest Mean scores of Varied Ability of the Experimental Groups (EGs) and Control Group (CG).

Teaching Methods	Varied Abilities	N	Mean	Std. Deviation	MeanDifference (EG – CG)
Lecture	Low	25	53.5200	3.42929	
					-7.23214
	Average	96	45.5417	10.80148	
					-.92626
	High	79	37.2658	9.35991	
	Total	200	43.2700	11.02063	
Inquiry	Low	36	63.7222	9.51573	
					5.07317
	Average	92	62.0652	8.65683	
					1.28856
	High	22	48.0909	9.70964	
	Total	150	60.4133	10.34777	

It can be seen from Table 4.5a that the total mean score of students with varied abilities of the Experimental Group one (EG1), that is, Inquiry methods was 60.41with standard deviation of 10.35 while the Control Group (CG) that is lecture method has 43.27 with standard deviation of 11.02. It clear from the result in Table 4.5a shows that the Experimental Group one exposed to Inquiry teaching methods performed better than their counterparts exposed to lecture method based on their varied ability.

Table 4.5bMeans and Standard Deviations of the Posttest Mean scores of Varied Ability of the Experimental Groups (EGs) and Control Group (CG).

Teaching Methods	Varied Abilities	N	Mean	Std. Deviation	MeanDifference (EG – CG)
Lecture	Low	25	53.5200	3.42929	
	Average	96	45.5417	10.80148	-7.23214
	High	79	37.2658	9.35991	-.92626
	Total	200	43.2700	11.02063	
Demonstration	Low	34	63.3235	11.46462	
	Average	89	61.5506	9.79217	15.06504 . 39325
	High	27	46.5926	10.72474	
	Total	150	59.2600	11.90760	

It can be seen from Table 4.5b that the total mean score of students with varied abilities of the two Experimental Group two (EG2), that is, Demonstration methods was 59.26 with standard deviation of 11.91 while the Control Group (CG) that is lecture method has 43.27 with standard deviation of 11.02. It clear from the result in Table 4.5b shows that the Experimental Group two exposed Demonstration teaching methods performed better than their counterparts exposed to lecture method based on their varied ability.

NullHypothesis 5 (H_O5): There is no significant difference in varied abilities when students are taught Wave Concepts using Inquiry, Demonstration and Lecture teaching methods. To test Null Hypothesis five, ANOVA Results of Posttest Mean Scores Physics Students of varied ability of the Experimental Groups (EGs) and Control Group (CG)was used. The detail of the results is presented in Table 4.5c

Table 4.5cANOVA Results of Posttest Mean Scores of SS II Physics Students of Varied Ability of the Experimental Groups (EGs) and Control Group (CG)

Varied ability score category

Methods	Groups	Sum of Squares	df	Mean Square	F	Sig.
Lecture	Between Groups	179.409	2	89.704	.737	.480
	Within Groups	23990.011	197	121.777		
	Total	24169.420	199			
Demonstration	Between Groups	657.542	2	328.771	2.361	.098
	Within Groups	20469.318	147	139.247		
	Total	21126.860	149			
Inquiry	Between Groups	119.828	2	59.914	.556	.575
	Within Groups	15834.546	147	107.718		
	Total	15954.373	149			

*. The mean difference is significant at the 0.05 level.

Analysis from the Table 4.5b indicatesthat the calculated F – value of the Experimental Groups (EGs) are.737and2.361with the degree of freedom Between Groups and WithinGroups 2 and 497, degree of freedom total is 499. While the Control Group (CG) hasF – value of .556. This value is greater than t – value at alpha = 0.05 level of significance, it shows that this means there issignificant differences between the post test scores of students with varied ability of the EG and CG that is, Inquiry, Demonstration

methods and lecture method. Thus the hypothesis is rejected. Moreover the P – value is 0.98. This indicates a significant difference in the varied ability of the three groups at alpha value of 0.05 with total degree of freedom df_t = 499. This means that there is significant difference between the post test score of students with varied ability of the experimental and the control group in favour of the experimental groups that is, Inquiry and Demonstration methods. Thus, the hypothesis is rejected. This implies that the experimental group taught the wave concepts using Inquiry and Demonstration methods significantly varied higher than the control group taught the same concept using lecture method.

Table 4.5dScheffe Tests of Posttest Mean Scores of Physics Students with Varied Ability of the Experimental Groups (EGs) and Control Group(CG).

Methods	(I) Varied ability score category	(J) Varied ability score category	Mean Difference (I-J)	Sig.	Remark
Lecture	Low	Average	6.30588	.624	Sig.
		High	7.23214	.535	Sig.
	Average	Low	-6.30588	.624	Sig.
		High	.92626	.844	Sig.
	High	Low	-7.23214	.535	Sig.
		Average	-.92626	.844	Sig.
Demonstration	Low	Average	-14.67179	.113	Sig.
		High	-15.06504	.098	Sig.
	Average	Low	14.67179	.113	Sig.
		High	-.39325	.980	Sig.
	High	Low	15.06504	.098	Sig.
		Average	.39325	.980	Sig.
Inquiry	Low	Average	-3.78462	.827	Sig.
		High	-5.07317	.708	Sig.
	Average	Low	3.78462	.827	Sig.
		High	-1.28856	.757	Sig.
	High	Low	5.07317	.708	Sig.
		Average	1.28856	.757	Sig.

It can be seen fromthe post hoc test result in Table 4.5c that the mean scores difference of

the two Experimental Groups (EGs), that is, Inquiry and Demonstration methods was .0533 and –.0533 respectively with the significant level of .663 while the Control Group (CG), That is, lecture method has .8050 with the significant level of .001.Therefore, from the results in Table 4.5c, it shows that the Experimental Groups exposed to Inquiry and Demonstration methods performed better than their counterparts exposed to lecture method based on varied ability.

Research Question6: What is the difference among rural and urban Senior Secondary Two (SS II) Physics students taught waves concept using Inquiry, Demonstration and Lecture methods of teaching?

To answer question six, a descriptive statistics of mean and standard deviation were used. The detail of the results is presented in Table 4.6a

Table 4.6a Posttest Mean Scores among Rural and UrbanSS II Physics Students of the Experimental Groups (EGs) and Control Group (CG).

Location	N	Mean	Std. Deviation	Std. Error	Mean Difference (R – U)
Rural	270	47.56	13.385	.815	3.640
Urban	230	59.85	10.923	.720	
Total	500	53.21	13.746	.615	

*. The mean difference is significant at the 0.05 level.

The result in Table 4.6a, indicates that the total mean score among rural and urban SS II physics students of varied ability of the two Experimental Groups (EGs), that is, Inquiry and Demonstration methods and the Control Group (CG). That is, lecture method show that the mean score of rural is 47.56 and 59.26 with standard deviation of 13.39 while urbanhas

the mean score of 59.85 with standard deviation of 13.75. Therefore, the urbanphysics students performed better than their counterparts in the rural area.

NullHypothesis 6 (H_O6): There is no significant difference among rural and urban Senior Secondary Two (SS II) Physics students taught wave concepts using Inquiry, Demonstration and Lecture methods of teaching.

To test Null Hypothesis six, ANOVA Analysis of Posttest Mean Scores among Rural / Urban Physics Students of the Experimental Groups (EGs) and Control Group (CG)were used. The detail of the results is presented in Table 4.6b

Table 4.6b ANOVA Results of Posttest Mean scores among Rural and Urban Physics Students of the Experimental Groups (EGs) and Control Group (CG)

Varied ability

Groups	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	18766.609	1	18766.609	123.755	.001	Sig
Within Groups	75518.341	498	151.643			
Total	94284.950	499				

*. The mean difference is significant at the 0.05 level

Analysis from the Table 4.6b indicates that the calculated F – value is 123.755 with the degree of freedom Between Groups and Within Groups 1 and 498, degree of freedom total is 499. This value is greater than t – value at alpha = 0.05 level of significance. This means there is significant differences among the post test scores of rural and urban physics students taught using the EG and CG, that is, Inquiry, Demonstration methods and lecture

method. Thus the hypothesis is rejected. Moreover the P – value is 0.01. This indicates a significant difference in the varied ability of the three groups at alpha value of 0.05 with total degree of freedom $df_t = 499$. This shows that there is significant difference among the post test score of rural and urban physics students taught using Inquiry and Demonstration methods also the one taught same concepts using lecture method. Thus the hypothesis is rejected. This implies that Urban physics students taught the wave concepts using Inquiry and Demonstration methods of teaching also the one taught the same concepts using lecture method significantly varied higher than the rural physics students taught the same concepts using Inquiry and Demonstration methods and lecture method.

4.7 Summary ofFindings

i. There is significant difference in the mean scores of students taught Wave Concepts using Inquiry, Demonstration methods of teaching and their counterparts taught with the traditional lecture method to physics instruction in favour of the experimental groups among SS II physics students in Kano State.

ii. There is no significant difference in retention ability of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method.

iii. There is no significant difference in change of attitude when students are taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

iv. There is significant gender difference among the academic performances means scores of students taught Wave Concepts using Inquiry and Demonstration methods of teaching and those taught with the traditional lecture method to

physics instruction in favour of the female of the experimental groups among SSII physics students in Kano State.

v. There is no significant difference in varied abilities when students taught Wave Concepts using Inquiry, Demonstration and Lecture methods of teaching.

vi. There is significant difference in the mean scores between rural and urban Senior Secondary Two Physics students taught waves concept using Inquiry, Demonstration and Lecture methods of teaching

4.8 Discussion of Results

The study investigated the Impact of Inquiry and Demonstration methods on attitude, retention and performance among physics students of varied abilities; Kano State, Nigeria. To achieve this purpose, students in the experimental groups were taught wave concepts of physics using Inquiry and Demonstration methods of teaching (EG), the subject in control group (CG) were taught same concept using the traditional lecture method. The three groups (EGs & CG) were then post tested, post – posttest and their performance and attitude were compared according to the variable being measured. The data generated from the administration of the instruments namely; Physics performance test (PPT) and Waves Concept Attitude Scale Questionnaire (WCASQ). The design of the study as reported in the chapter three and the analysis was carried out using the SPSS statistical package version 16.0. The discussion of the result and summary of the finding are reported as follows:

Null Hypothesis 1: The result from testing this hypothesis showed that the subjects in the experimental groups (EGs) who were taught wave concepts of physics using Inquiry and Demonstration methods of teaching performed better than their counterparts in the control group (CG) who were taught same concepts using traditional instructional method. The

significant difference in favour of the experimental groups (EGs) suggests greater impact of the Inquiry and Demonstration methods over the traditional method. This finding is in conformity with those of Bichi (2002) and Lawal (2009) who reported the usefulness of the approach in students' performance and retention of Biology concepts. The superiority of the strategies over the traditional teaching method has also been reported by Owolabi (2006) who compared the effectiveness of the strategies with the traditional methods in teaching of physics. The impact of Inquiry and Demonstration methods may be attributed to the warfare of the instruction itself, which is less teacher – directed but more learner centered, which thus, provide a variety of activities for the students to control their actions in the process of learning.

The relatively poor performance of students in the control group in Physics Performance Test (PPT) is an indication that the lecture method adopted in teaching physics by physics teachers is not quite effective in promoting meaningful learning of physics. This is supported by the observation of Owolabi (2006), that the meaning field learning takes place when teaching is instructed alongside instructional methods that promotes active participation of students in the learning process.

The result of this study is also an indication that students of all ability group performed significantly better in class room where inquiry and demonstration methods are used. This finding is in tandem with those of Wilkinson (2002) and Chinwe (2009) who independently reported that good teaching strategies can circumvent problems with low ability groups while maintaining high performance with higher achievers. It can thus be inferred from the results of the study that low performance among the low ability students can be remedied by exposing them with Inquiry and Demonstration methods of teaching.The findings from

this study indicated that Inquiry and Demonstration methods can enhance academic performance among students of all the ability levels. It also shows that teaching through Inquiry and Demonstration methods can influence students in a given ability to perform significantly better than others of the same group taught via traditional method.

Null Hypothesis 2: The results from testing Hypothesis 2 showed that there is no significant difference in the retention ability of students taught wave concepts of physics using Inquiry and Demonstration methods and their counterparts using lecture method. The ANOVA results of the post – posttest score of the subject revealed that no significant difference in the retention ability of students in the experimental groups (EGs) and their counterpart taught same concepts using traditional method is not significantly affected by gender. This finding is in agreement with the finding of Sambo (2005) and Lakpini (2006) who independently reported no observed difference between boys and girls in the retention abilities.The insignificant difference in retention the learnt physics concepts this study, could be linking to the instructional strategies used, i.e Inquiry and Demonstration methods. This provide the answer to research question 2 which states thus; 'What is the impact of Inquiry and Demonstration methods on the retention of learnt physics concepts among senior secondary II (SSII) students'.

The methods provide for active learning process in which the students had to think hard to solve the given problems as a result of which meaningful learning resulted. Studies on retention and instructional methods seem to agree that those instructional methods that are characterized by active learning such as Inquiry and Demonstration instructional models yield permanent and meaningful learning that is readily retained and remembered at will by the learner. Oyedokun (2006) also needed for science teachers to emphasize Inquiry and

Demonstration methods in the teaching of science. The finding also supported Anyagh (2006) who discovered that the retention takes place more effectively when experience are passed across to the learner via an appropriate teaching strategies.Sambo (2005) noted that learners who were exposed to a variety of effective learning style are more likely to be efficient learners who developed high performance as greater retention and attention.

Null Hypothesis 3: states that there is no significant difference in the change of students attitude taught wave concepts using Inquiry and Demonstration methods and those taught same concepts using traditional method. The results confirmed in Table 4.4 show that a significant difference in change of attitude of the three groups i.e the experimental groups and control group. The P- value 0.001 at 0.005 level of significant further confirms significant difference between the control and experimental groups. This result showed attitudinal change in the subjects in the group taught wave concepts using Inquiry and Demonstration methods compared to those taught same concepts using lecture method. This attitudinal change to the physics concepts taught can be attributed to the strategies used for the teaching. The attitude expressed by the experimental groups can also be described as being a favourable one and can be attributed to the Inquiry and Demonstration methods used in teaching the subjects. The favourable attitude could be attributed to the educational benefits the subjects derived from the use of the methods.

These benefits include the improvement of the methods had on the performance of the students in the physics concepts taught, exposure of students to varied activities as well as the interpersonal relation among the students. Also the free atmosphere and relaxed relationship between learner and the teacher who acted only as a guide into the teaching process. This finding is in support of the assertions of Ahove cited in Lawal (2008) where

she stated that positive attitude of learners towards a subject enhanced meaningful learning and better concepts formation.

The finding of Nwosu (2003) is also in support of the present study, Nwosu found that the experimental group taught using Inquiry and Demonstration methods, had a significantly more attitude to physics than the control group taught using traditional method.

Null Hypothesis 4:Centered on gender related differences in academic performance in relation to the variable of the study. The results showed that there was significant gender difference among the academic performances means scores of students taught Wave Concepts using Inquiry and Demonstration methods and those taught with the traditional lecture method to physics instruction in favour of the female of the experimental groups among SSII physics students in Kano State.

These findings of significant in performance of boys and girls taught using Inquiry and Demonstration teaching methods are supported by the finding of Sambo (2005), Oyedukun (2005) and Lakpini (2006). The finding however, conflict with those of same other researchers who reported no significant difference in performance either in favour of boys or girls in the area of science. The findings of Bichi (2002) and Aweriale (2006) showed no significant difference between male and female performances in science. Ogunleye (2006), Raimi (2007),Morribend (2008), and Chukwuka (2009) individually reported that males perform better than their female counterparts in physicssubject. Okeke (2009) also reported significant effect of gender on learning outcomes in favor of the male students. Ivowi (2008), Solomon (2009) and Duyilemi (2010) reported significant difference in performance in favor of males in their research. Oluwatoyin (2010) observed that women perform better when they are exposed to science.

Null Hypothesis 5: The result in Table 4.5 showed that there is no significant difference in varied abilities when students are taught Wave Concepts using Inquiry, Demonstration and Lecture teaching methods. The summary of the differences of the ability groups with respect to performance using ANOVA test showed that no significant difference in the varied ability as students taught using Inquiry and Demonstration methods. Research question 5 which reads "What is the impact of inquiry and demonstration methods on the academic performance of the students with varied abilities, with the respect to performance in physics among SSII physics students?", with low, median and high ability is thus answered. It is now empirically established that inquiry and demonstration teaching methods have the impact even to the students with different ability levels

The findings of the research concurred with those of Allania (2005) and Anaso (2008) who independently compared the performance of students in ability – based and mixed ability groups in science and reported a higher students' performance when exposed to physics instruction using inquiry and demonstration teaching methods.

Null Hypothesis 6: The result in Table 4.6 from testing null hypothesis 6 show that there is no significant difference among rural and urban Senior Secondary Two (SS II) Physics students taught waves concept using Inquiry, Demonstration and Lecture methods of teaching.Table 4.6 revealed that there was significant difference in the mean score rural and urban SS II physics students. The outcome demonstrated that urban physics students performed better than rural physics students taught that same concepts.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the objectives of the study, the methodology employed to collect data and summary of the findings are briefly outlined. The conclusions emanating from the findings, subsequent recommendations are also outlined. The chapter ends with the highlights of the limitations of the study and suggestions for further studies.

5.2 Summary

The study investigated impact of Inquiry and Demonstration methods on attitude, retention and performance among secondary school physics students with varied abilities levels, and compared with similar performance and retentionvia traditional lecture method. It also investigated effect of gender – related differences on students' academic performance in wave concepts of physics when students exposed to Inquiry, Demonstration and lecture methods. The sample comprised a total of five hundred (500) senior secondary two (II) physics students drawn from six senior secondary schools out of thirty nine (39) senior secondary schools of Dawakin Kudu Education Zone, Kano State.

Two instruments: A 50 - item multiple choice instrument, the Physics Performance Test (PPT) with the reliability coefficient 0.89 and Wave Concepts Attitude Scale Questionnaire (WCASQ) with the reliability coefficient 0.97 were used to collect data. The data generated were analyzed according to the demands of the six hypotheses formulated to guide the study and the design of the study as reported in chapter 3. Data analysis was carried out using SPSS statistical package version 16.0. The discussion of the results and summary of the findings were reported accordingly. Analysis of the results indicates a superiority of

Inquiry and Demonstration methods over lecture method and it was found to be gender friendly and suitable for students of varied ability levels.

5.3 Summary ofMajor Findings

At the end of this study, the following major findings were made:

i. There is significant difference between the academic performance of students exposed to Inquiry and Demonstration methods and those exposed to the traditional lecture method

ii. There is no significant difference in the retention level of those taught wave concepts of physics using Inquiry and Demonstration methods among low, medium and high ability SS II Physics students' in Kano State

iii. There is significant change in students' attitude towards physics after their exposure to Inquiry and Demonstration methods. That is, students exposed to Inquiry and Demonstration methods developed more positive attitude toward physics than those exposed to the traditional lecture method

iv. There is no significant difference between the academic performance of female and male physics students taught wave concepts of physics using Inquiry and Demonstration methods among low, medium and high ability SS II Physics students' in Kano State. Therefore, the strategies are gender friendly.

v. There is no significant difference in the performance level of those taught wave concepts of physics using Inquiry and Demonstration methods among low, medium and high ability SS II Physics students' in Kano State

vi. There is no significant difference between the academic performance of urban and rural physics students taught wave concepts of physics using Inquiry and Demonstration methods among low, medium and high ability SS II Physics students in Kano State

5.4 Conclusions

Based on the findings of this study, the following conclusions were made:

1. Inquiry and Demonstration methods improve the academic performance of senior secondary school students in physics
2. Inquiry and Demonstration methods increase the performance of students with varied ability.
3. Physics concepts are retained when Inquiry and Demonstration methods are used as a medium of instruction
4. Both gender benefitted equally well when taught using Inquiry and Demonstration methods. That is, Inquiry and Demonstration methods promotes acquisition and retention of physics concepts across all gender
5. Students exposed to Inquiry and Demonstration methods developed more positive attitude than those exposed to traditional lecture method.

5.5Contributions to Knowledge

Based on the finding of this research, the following contributions were made:

1. Inquiry package, flowchart and lesson plan were adapted and modified by the researcherfor the purpose to guide in administering instruments to the experimental group one that is students exposed with inquiry method of teaching which lead to

students exposed to the real – world application, exchange of idea through conversation and providing opportunity for students to write and voice their observation also aid in the retention of learned physics concepts.

2. The demonstration instructional package, flowchart and lesson plan were adapted and modified by the researcher for the purpose to guide in administering instruments to the experimental group two that is students exposed with demonstration method of teaching whichencourage students collaboration, exchange of idea through conversation and providing opportunity for students to write and voice their observation. Alsoenhancing the academic performance of physics students with varied abilities.
3. The Inquiry and Demonstrationapproach is gender friendly as both female and male students exposed to the Inquiry and Demonstration methods benefit equally.That is Inquiry and Demonstration methods are efficious in eliminating gender related differences in science learning.
4. Physic Performance Test (PPT) was developed by the researcher using six levels of metal process of the cognitive domain outline by Bloom and adapted from obeka (2012) to test students' academic performances in wave concepts and found to be effectual. This unique in this field
5. Wave Concepts Attitude Scale Questionnaire (WCASQ) were Adapted by researcher for the purpose of testing attitude of students in wave concepts so as to enhance teaching and learning physics concepts.

5.6 Recommendations

Based on the findings emanating from this study, the following recommendations were made:

1. The Inquiry and Demonstration methods should be incorporated into the main stream of pedagogy in the teaching of physics at secondary school levels by Nigerian Educational and Research Development Council (NERDC) becausethis study establish that there is significant difference between the academic performance of students exposed to Inquiry and Demonstration methods and those exposed to the traditional lecture method.
2. In - service training for science teachers should be organized and focus more on how to use Inquiry and Demonstration methods for the teaching physics concepts by the government research centers like Nigerian Educational and Research Development Council (NERDC), Nigeria Institute of Physics (NIP) and relevant professional bodies like Science Teachers' Association,.
3. Seminars, workshops and conferences should be organized and focus more on how to use Inquiry and Demonstration methodsamong low, medium and high abilityfor the teaching physics concepts by the government agencies of education and relevant professional bodies like Science Teachers' Association, Nigeria Institute of Physics (NIP) and research centers like Nigerian Educational and Research Development Council (NERDC)
4. Researchers and physics students should trainby their respective teachers on how to interact positively and encourage individual best performance in physics subject. That is Physics students should perform better and have positive attitude

toward Physics through the use of Inquiry and Demonstration teaching methods and hence build stronger foundation to Physics Skills.

5. The Inquiry and Demonstrationmethods are gender friendly and established that gender does not play a significance role in the learning of wave concepts of physics using Inquiry and Demonstration methods. Hence, methods are recommended as they are gender friendly and aided learning between male and female students.
6. Teacher trainers'institutions like the college of Education and university, faculty of Education should incorporate Inquiry and Demonstration methods into their methodology curricular at all level. This will ensure the development of its knowledge in the teachers on training.
7. There should be provisions of physics facilities, equipment's and materials by government and donor agencies for effective use of Inquiry and Demonstration methods.

5.7 Limitations of the Study

This study has some limitations which include the following:

1. The schools used for this study were six Government Senior Secondary Schools in Dawakin Kudu Education Zone in Kano State which narrow the scope of the generalizations of findings. The generalization could not be extended to other schools obtainable in the state like private schools, Military school and Federal Government Schools.

2. The conclusions reached in this study are restricted to the impact of Inquiry and Demonstration methods on the teaching of wave concepts of physics at Senior Secondary Schools of Kano State.
3. The pilot study for this research is conducted on Girls School only.
4. Some of the period used for physics lesson were in the afternoon

5.8 Suggestions for Further Studies

From the available literature, it is obvious that not much had been covered in the area of Inquiry and Demonstration methods, most especially in physics. The researcher is thus of the opinion that further studies be carried out to cover other concepts. The following suggestions are therefore made to further expend the scope of this study:

1. A similar study should be carried out focusing on the teaching of Biology, Chemistry or Mathematics using the Inquiry and Demonstration methods with a view to finding out if similar or different results as in this study might be obtained.
2. Inquiry and Demonstration methods can be used with other teaching strategies notably science processes skills approach, concepts mapping, to mention just a few on the teaching of physics concepts
3. The study can be extended to the university students to investigate if educational level has an effect on the variables that this study dealt with.
4. There is need to further investigate the role, if any, that gender differences play in the interactions between teaching methods and kind of curriculum as different studies seem to be showing different results.

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APPENDIX I

PHYSICS PERFORMANCE TEST (PPT)

PPT will be used to determine the impact of Inquiry and Demonstration methods on attitude, retention and performance among physics students of varied ability; Kano State, Nigeria using the concepts wave. The following are the questions for PPT.

1. The diagram below shows a wave form in which energy is transferred from X to Y in a time of 0.2×10^{-3}s. What is the frequency of the wave.



A. 2.0×10^{-3}Hz B. 3.0×10^{-3}Hz C. 1.0×10^{3}Hz D. 4.0×10^{-3}Hz

2. The wave length of ultraviolet radiation is 400nm. If the speed of light in air is 3×10^{8}ms^{-1},then the frequency of the ultraviolet radiation is
A. 1.3×10^{15} HZ B. 7.5×10^{5} HZ C. 1.2×10^{11} HZ D. 7.5×10^{14} HZ

3. A radio station broadcast at a frequency of 400KHz. If the speed of the wave is 3×10^{8} ms^{-1} , calculate the wavelength of the radio wave
A.7.9 X 10^{2} M B, 8.1 X 10^{2} M C. 7.5 X 10^{2} M D. 7.0 X 10^{2} M

4. A periodic travels a distance of 20.0m in 1.00s. If its frequency is 2.0×10^{3} Hz, calculate the wavelength.
A. 1.0×10^{-2} m B. 2.0×10^{-2} m C. 1.0×10^{-3} mD. 1.0×10^{-4} m

5. A wave has a frequency of 2Hz and a wave length of 30cm. The velocity of the wave is A. 60.0cm^{-1} B. 6.0ms^{-1} C. 1.5ms^{-1} D. 0.6ms^{-1}

6. A boat at anchor is rocked by waves whose crests are 100m apart and whose velocity is 25ms^{-1}. At what interval does the wave crest reach the boat?
A. 2500.00s B. 75.00s C. 4.00s D. 0.25s

7. Infrared rays of frequency 1.0×10^{13} Hz have a wave length of 3.0×10^{-5} m in vacuum. The wavelength of X – rays of frequency 5.0×10^{16} Hz in vacuum will be

A. 6.0×10^{-23} m B. 6.0×10^{-9} m C. 6.0×10^{-7} m D. 5.0×10^{16} m

8. The wavelength of a stationary wave is 36.0cm. What is the distance between a node and the next anti – node?
A. 5.0cm B. 6.0cm C.9.0cm D. 1.0cm

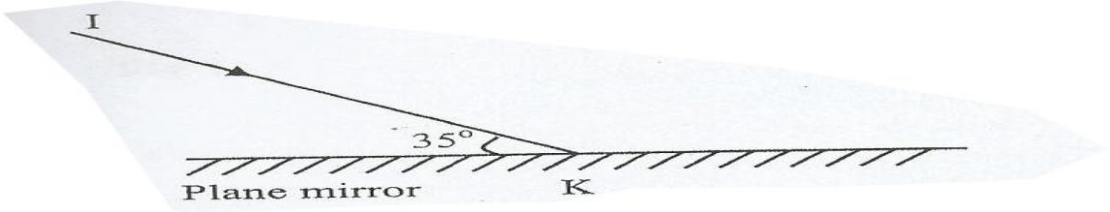
9. A wave of frequency 10Hz forms a stationary wave pattern in a medium where the velocity is $20cm^{-1}$. The distance between adjacent node is
A. 1.0cm B. 1.5cm C. 2.0cm D. 5.0cm

10. Radio waves emitted from an antenna are picked up by radar after reflection from an aircraft in 4×10^{-3} s. How far is the aircraft from the antenna? ($v= 3 \times 10^3$ ms)
A. 6.0×10^2 km B. 1.3×10^2 km C.3.0×10^2 km D. 6.0×10^5 km

11. The distance between two points P and Q, along a wave is 0.05m. If the wavelength of the wave is 0.10m, determine the phase angle between P and Q in radians.
A. 3π B. 2π C. 1π D.4π

12. A boy1.5m tall stands 2.0m in front of a pinhole camera of length 20.0cm. Calculate the height of his image.
A. 10cm B. 20cm C. 15cm D. 25cm

13. The diagram below shows a ray of light IK incident on plane mirror at k.



Calculate the angle of deviation of the ray after refection.
A. 60^0 B. 80^0 C. 70^0 D. 90^0

14. A ray of light strikes a plane mirror at a glancing angle of 55^0. Calculate the angle between the incident and reflected rays.
A. 50^0 B. 60^0 C. 70^0 D. 80^0

15. A object is placed 10cm in front of a plane mirror. If it is moved 8m farther a way from the mirror, determine the distance of the final image from the mirror
A. 16 B. 18cm C. 17cm D. 19cm

16. A man stands 4m in front of a plane mirror. If the mirror is moved 1m towards the man, the distance between him and his new image is
A. 6m B. 8m C. 7m D. 9m

17. A candle is place between two mirror which are inclined at an angle of 72^0 and facing each other. How many images will be observed in the two mirrors?

A. 6 B. 8 C. 7 D. 4

18. A t what angle θ will 2 plane mirrors be inclined so that 11 images will be formed when an object is placed in front of the two mirrors?
A. 60^0 B. 80^0 C. 70^0 D. 30^0

19. Arayof light is incident on plane mirror at an angle of 20^0. This mirror is rotated through twice this angle. In this new position, the angle between the incident ray and the reflected ray is A. 160^0 B. 80^0 C. 120^0 D. 90^0

20. The image of an object is located 6cm behind a convex mirror. If its magnification is 0.6, calculate the focal length of the mirror.
A. – 2.6cm B. -1.70cm C. -3.62cm D. -3.75cm

1. An object is placed in front of a concave mirror whose radius of curvature is 12cm. If the magnification of the image produced is 1.5, how far is the object from the mirror?
A. 6cm B. 8cm C. 10cmD. 9cm

22. A concave mirror of radius of a curvature 40cm forms a real image twice as large as the object. The object distance is
A. 16cm B. 20cm C. 30cm D. 40cm

23. An object is placed 10cm in front of a concave mirror of focal length 15cm. What is the position and nature of the image formed?
A. 30cm and virtual B. 16cm and real C. 6cm and virtual D. 30cm and real

24. A beam of light is incident front air to water at an angle of 30^0. Find the angle of reflection if the reflective index of water is 4/3.
A. 16^0 B. 18^0 C. 22^0 D. 24^0

25. Light of velocity $3.0 \times 10^8 ms^{-1}$ is incident on a material of reflective index n. If the velocity of light is reduced to $2\text{-}4 \times 10^8 ms^{-1}$ in the material, what is n
A. 2.33 B. 2.26 C. 1.33 D. 1.25

26. By what factor will the size of an object placed 10cm from a convex lens be increased if the image is seen on a screen placed 25cm from the lens?
A. 15.0 B. 1.7 C. 2.5D. 0.5

27. A thin converging lens has a power of 4.0 diapers. Determine its focal length
A. 0.25m B. 0.03m C. 5.0m D. 2.5m

28. A source of sound produced waves in air of wavelength 1.65. If the speed of sound in air is $330ms^{-1}$, the period of vibration in second is
A. 0.08s B. 0.07s C. 0.005sD. 0.009s

29. In a sound wave in air, the adjacent rarefactions and compressions are separated by a distance of 17cm. If the velocity of the sound waves is 340ms^{-1}. Determine the frequency
A. 10Hz B. 20Hz C. 100HzD. 570Hz

30.The speed of sound in air is 330ms-1. How far from the centre of a storm is an observer who hears a thunder clap 2s after the lightning flash? [Neglect the time taken by light to travel to the observer]
A. 166m B. 120m C. 550mD. 660m

31. A fathometer is used to send a wave down to the sea bed. The *reflected* wave is received after 0.5seconds. Calculate the depth of the sea [Speed of sound in water = 1500ms-1]
A. 220m B. 370m C. 375mD. 275m

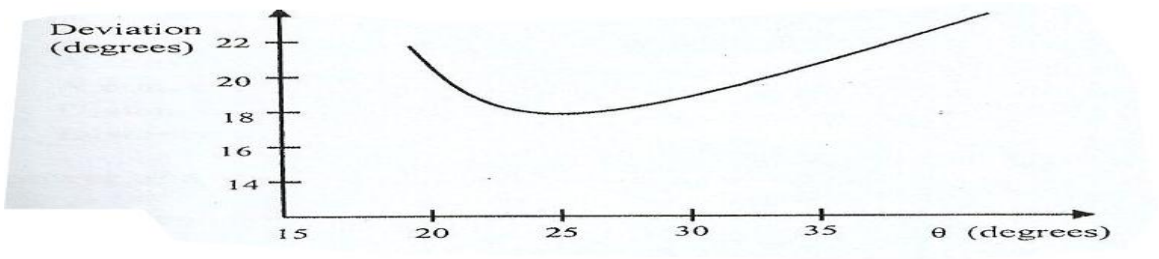
32. A man standing 510m a way from a well sounds a whistle. The echo from the wall reaches him 3s later. Calculate the velocity of the sound in air.
A. 144m^{-1} B. 402m^{-1} C. 340m^{-1} D. 250m^{-1}

33. How far a cliff should a boy stand in order to hear the echo of his clap 0,9s later? [Speed of sound in air = 330ms^{-1}]
A. 12.20m B. 13.70m C. 137.5mD.148.50m

34. A man hears his echo from a nearby hill 2s after he shouted. If the frequency of his voice is 260 Hz and the wavelength is 1.29m. How far is the hail?
A. 225.1ms^{-1} B. 370.2ms^{-1} C. 375.5ms^{-1} D. 335.4ms^{-1}

35. A ray light experiences a minimum deviation when passing systematically through an equilateral triangular glass prism. Calculate the angle of incidence of the ray [Refractive index of glass = 1.5]
A. 41.6^0 B. 31.8^0 C. 48.6^0 D. 24.9^0

36.The figure below shows a plot of angle of deviation through a glass prism when light is incident at θ degrees on the prism.



The incident angle that produces the minimum deviation is A. 16^0 B. 18^0 C. 22^0 D. 25^0

37. A bat emits a sound wave at a speed of 1650.0ms-1 and receives the echoes 0.15s later. Calculate the distance of the bat from the reflector
A. 112.20m B. 213.70m C. 123.75mD.148.50m

38. A hunter 412.5m a way from a cliff, move a distance x towards the cliff and fires a gun. He hears the echo from the cliff after 2.2 seconds. Calculate the value of x [speed of sound in air = $330ms^{-1}$]
A. 12.2m B. 13.7m C. 37.5mD.49.5m

39. The lowest note emitted by a stretched string has a frequency of 40Hz. How many overtones are there between 40Hz and 150Hz?
A. 4 B. 3 C. 2 D.1

40. Calculate the wavelength of the note which is one octave lower than a note of 256Hz in a medium in which the speed of sound is $352ms^{-1}$
A. 2.75m B. 3.70m C. 7.15mD.8.50m

41. A pipe closed at one end is 100cm long. If the air in the pipe is set in to vibration and a fundamental note is produced, calculate the frequency of the note [velocity of sound in air = $340ms^{-1}$]
A. 70.1Hz B. 20.5Hz C. 100.0HzD. 85.0Hz

42. A pipe closed at one 1.0m long. The air in the pipe is set into vibration and a fundamental note of frequency 85Hz is produced. Calculate the velocity of the sound in the air [Neglect end correction]
A. $144ms^{-1}$ B. $402ms^{-1}$ C. $340ms^{-1}$ D. $250ms^{-1}$

43. Thewavelength of the first overtone in closed pipe of length 33cm is
A. 16cm B. 38cm C. 44cmD. 29cm

44.If the fundamental frequency of a close pipe organ on a day when the speed of sound is 34ms-1 is 170Hz, then the length of the pipe is
A. 60cm B. 80cm C. 50cmD. 90cm

45. An organ pipe of length 40cm opened at both ends sounds its fundamental note. Neglecting and corrections, calculate the frequency of the note [speed of sound in air = $340ms^{-1}$] A. 702Hz B. 205Hz C. 425HzD. 85Hz

46. A tuning fork of frequency 600Hz is sounded over a closed resonance tube. If the first and second positions are 0.130m and 0.413m respectively, calculate the speed of sound in air.
A. $144.6ms^{-1}$ B. $402.2ms^{-1}$ C. $339.6ms^{-1}$ D. $250.4ms^{-1}$

47. In a resonancetube experience, if the fundamental frequency of the vibrating air column is 280Hz, the frequency of the third overtone is
A. 1702Hz B. 2205Hz C. 1425HzD. 1960Hz

48. A sonometer wire has a frequency of 259Hz. It is sounded alongside a tuning fork of frequency 256Hz. Calculate the beat frequency.
A. 2Hz B.5Hz C. 4HzD. 3Hz

49. If the first position of resonance tube is 18.0cm from the open end, the distance from the open end to the next position of resonance will be?
A. 54cm B. 38cm C. 44cmD. 29cm

50. In a resonance tube of fixed length is closed at one end several tuning fork of increasing frequency used to obtain resonance at the open end, if the tuning fork with lower frequency which gave resonance had a frequency f_1 and the next tuning fork to give resonance had a frequency f_2, find the ratio f_2/f_1
A. 1/2 B. 3 C. 1/4 D. 2

APPENDIX II

MARKING SCHEME

1. C	11. C	21. C	31. C	41. D
2. D	12. C	22. C	32. C	42. C
3. C	13. C	23. A	33. D	43. C
4.A	14. C	24. C	34. D	44. C
5. D	15. B	25. D	35. C	45. C
6. C	16. A	26. C	36. D	46. C
7. B	17. D	27. A	37. C	47. D
8. C	18. D	28. C	38. D	48. D
9. A	19. C	29. C	39. C	49. A
10. A	20. D	30. D	40. A	50. B

APPENDIX III

LESSON PLAN FOR EXPERIMENTAL GROUP I (INQUIRY)

WEEK ONE

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPAGATION AND REPRESENTATION OF WAVES

METHOD OF TEACHING: Inquiry Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone, water, cardboard paper, marker of three different colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1. Identify and define waves
2. Propagation of waves
3. Draw the representation of waves

PREVIOUS KNOWLEDGE: Students have learnt about Heat, Type of Heat example, Heat energy, Heat transfer etc

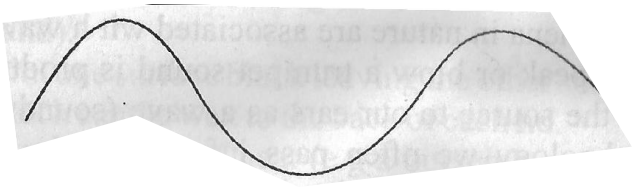
INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

1. Define the term Heat concept?
2. Explain the type of Heat
3. The topic would be introduced to studentsexampleDefinition of waves, propagation and representation of waves

PRESENTATION: The lesson presented in the following steps

STEP1:The topic would be introduced to students by Define of waves, propagation and representation of waves.

STEP 2: Students were given guide by the teacher to exhibit how waves were propagated with practical of the concept waves so as the students observe,identify how waves were propagated example Fill a large basin with water. Place a piece of cork on the water surface at some distance from the center of the basin. Drop a piece of small stone form a height into the water. As the stone strike the water, observe the pattern of the disturbance produced. Also observe the motion of the cork. You will find out that circular disturbance spread outward from the point where the stone hits the water this is a water wave. Also you will notice that as the wave spread past the cork, the cork only bob up and down (oscillates) in the water. It does not travel with the medium. This show that the water molecule are not the one carrying energy from one point to another rather they vibrate about a fixed position b. for wave in a string tie a rope about 5m long to a rigid support (eg a vertical pole). Hold the other end of the rope and stand about 4m long a way from the rigid support so that the rope sags slightly. Now move the free end of the rope up and down, observe the wave moving through the rope. The up and down movement constitutes a disturbance at one end of the rope which is now propagated along the length of the rope.



STEP3: Students discussion of findings from the exhibition example the parameter of waves such as amplitude, frequency f, period T, and speed of the wave (velocity; V). Examples in waves, there are usually ‘high’ and ‘low’ points. This is because a wave is a vibration. These point (‘high’ and ‘low’) repeat themselves at regular interval a long the wave motion. These ‘high’ and ‘low’ points are called crest and trough. For the wave described in the helical spring, we call the ‘high’ and ‘low’ point compression and rarefaction respectively. The distance between two successive crests or successive trough in a wave is called the wavelength of the wave

b. since a wave involve vibration, there is various position of displacement of the particle of the medium from their rest position. The maximum displacement from the position of rest is called amplitude. The S.I unit is metre (m). For convenience, however, amplitude may be expressed in cetimetre (cm) and millimeters (mm).

c. period is the time taken for one complete oscillation of a wave is called its period. It then means that period is the reciprocal of frequency i.e T =i/f

d. wave velocity (speed), v is the distance travelled by a wave in a time of one second in a medium. While frequency refer to the number of to and fro – motion (oscillation) of a wave per second.etc

STEP 4:- Discussion by students based on the findings about propagation and representation of waves concepts of physics

STEP5: The lesson evaluated by students and teacher response to students questions based on the findings and discussion on the wholeconcept of waves example that is Definition, parameters of waves, propagation and representation of the waves.

CONCLUSION: The lesson concluded after the studentshaveanswered the question correctly.

WEEK TWO

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: TYPE OF WAVES

METHOD OF TEACHING: Inquiry Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1. Define waves
2. Mention type of waves
3. Explain the type of waves

PREVIOUS KNOWLEDGE: Students have learnt about Definition of waves, propagation of waves and representation of waves etc

INTRODUCTION: The lesson introduced by asking studentsquestions on previous knowledge example

1. Who can define waves?
2. Explain propagation of waves
3. Draw the representation of waves
4. The topic would be introduced by mentioning the type of waves

PRESENTATION: The lesson would be presented in the following steps

STEP 1: The teacher explains to the students by mentioning the type of waves example Mechanical waves, Electromagnetic waves Transverse waves and longitudinal waves.

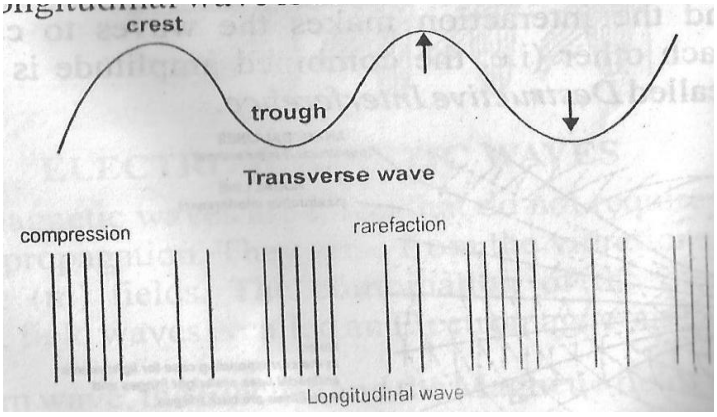
STEP 2: Students using practical for inquiry, identify type of waves example: Mechanical waves, Electromagnetic waves Transverse waves and longitudinal waves example

1. Mechanical waves is a type of wave that required a material medium for their propagation that is they cannot travel through vacuum. Mechanical also involve water waves, sound waves, waves on a rope or string etc

2. Electromagnetic wave is the waves that can pass through vacuum. They do not require any material medium for propagation, they are especially usefulin communication, electromagnetic wave which consists light waves, radio waves, x – ray and gamma rays etc

3. Transverse waves are waves in which the vibration of the particles of the is perpendicular to the direction of motion of the waves example all electromagnetic waves are transverse wave another example is water waves (ripple)

4. Longitudinal wave is waves whose vibrations are parallel to the directions of motion that is wave in helical spring which having compression and rarefaction and sound wave is another example of longitudinal waves.



STEP3: Discussion on students' findings that is what students identify from difference type of waves Transverse waves and longitudinal waves

STEP4: The lesson evaluated by students and teacher to response to students questions based on the findings and discussion, mentioning the type of waves example the Mechanical waves, Electromagnetic waves, Transverse waves and longitudinal waves.differentiation between those two waves.

CONCLUSION: The lesson concluded after the students haveanswered the questions correctly.

.

WEEK THREE

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPERTIES OF WAVES

METHOD OF TEACHING: Inquiry Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to

1. Define waves
2. Mention the properties of waves
3. Explain the properties of waves

PREVIOUS KNOWLEDGE: Students have learnt about type of waves etc

INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

1. Who can mention any two types of wave?
2. Explain mention any two types of wave?
3. The topic would be introduced by mentioning the properties of waves

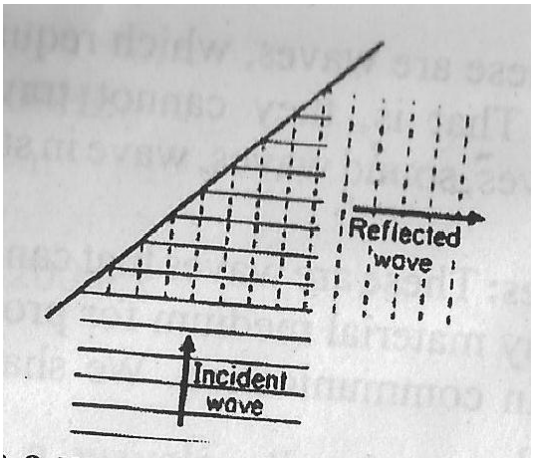
PRESENTATION: The lesson presented in the following steps

STEP 1: Theintroduced by mentions to the students the properties of waves example: Reflection,Refraction, Interference, Diffraction and Polarization

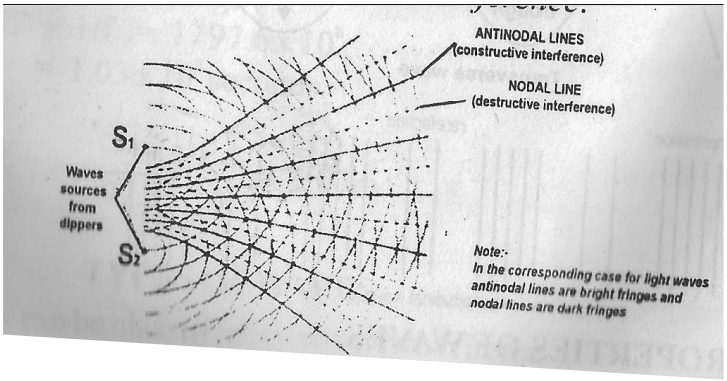
STEP2: The students using practical activity for inquiry identify the properties of waves example

1. Refraction are the change in speed and direction of the waves as they cross the boundary that when a wave moves from one medium to another, its direction may change at the boundary between the two medium. The change in direction is due to change in wave velocity as it passes from one medium to another. A straw dipped in a glass of water appears bent due to refraction of light when it passes from air to water also when one looks into a deep pool; it appears shallow because of refraction of light.

2. Reflection when waves meet a barrier in its path, it turns back. This is called reflection that is all waves exhibit reflection, the production of echo is due to reflection of sound waves, the formation of image in a mirror is due to reflection of light waves.

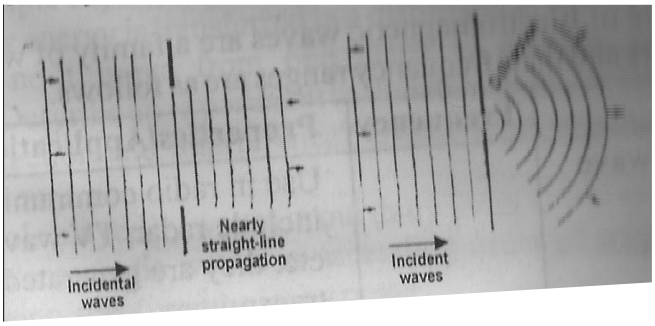


3. Interference when two waves moving along different path meet and interact, interference takes place. There are two types of interference; if when the two waves interact they re – enforce each other (ie the combined amplitude is greater than any one of the two waves) the interaction is called constructive interference and if on the other hand the interaction makes the waves to cancel out (neutralize) each other (ie the combined amplitude is zero) the interaction is called Destructive interference.

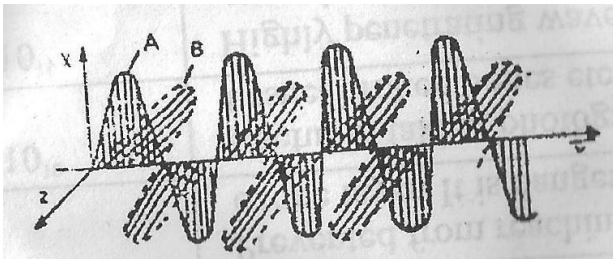


4. Diffraction of a wave depend on the size of the aperture relative to the wavelength of the wave for example doors and windows are big aperture that can cause the

diffraction of sound waves, but to cause the diffraction of light waves, diffraction of light requires very small aperture because the wavelength of the light is very small.



5. The polarization not all waves exhibit polarization but only transverse waves exhibit polarization. We said earlier that in transverse a wave the vibration is perpendicular to its direction of motion. These vibrations take place along all axes in planes perpendicular to the direction of motion. If a devices (means) can now cuff – off all vibration in all axes except one, then we say that the waves is polarized. That is vibration along one axes is perpendicular to its direction of motion and there are no other vibrations in any axis



STEP3: Discussion by students based on the findings about properties of wavesexample Reflection, Refraction, Interference, Diffraction and Polarization.

STEP4: The lesson evaluated by students and teacher response to students question based on the findings and discussion on Reflection, Refraction, Interference, Diffraction and Polarization. Example i. mention any two properties of wave ii. Who explain difference between those two properties of waves.

CONCLUSION: The lesson concluded after the students haveanswered the question correctly.

WEEK FOUR

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: SOUND WAVES

METHOD OF TEACHING: Inquiry Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define sound waves
2. Types of sound waves

PREVIOUS KNOWLEDGE: Students have learnt about waves and properties of waves etc

INTRODUCTION: The teacher introduces his lesson by asking students questions on previous knowledge example

1. Definition of waves?
2. Explain any two properties of waves?

PRESENTATION: The lesson presented with following steps

STEP I :- The teacher defined Sound waves: sound waves are generated whenever a body vibration mechanically in the frequency range of 20Hz to 20,000 Hz. Thus guitar string, membrane of a drum, or a bell, vibrates, sound wave are produced. The sound waves can be perceived by human ear. Hence the frequency of 20Hz to 20,000 Hz is called audible sound (audio frequency). When a body vibrates with a frequency greater than 20,000 Hz, the sound produced cannot be detected by human hearing organ. Hence, we call such sound ultrasonic

STEP II: The students' identify using inquiry method how topropagate sound waves that is Sound is a mechanical wave, hence it cannot travel through vacuum. Also when a sound vibrates, it compresses the layer air in contact with it. This compressed air vibrates and transfers the disturbance to the next layer. It then springs back to form a rarefied layer of air and the process repeat itself continuously. Hence, its speed is different in these media. Generally sound travels faster in solid and is slowest in gases. For example, at normal room temperature, the speed of sound in air is about330m/s; in a water it is about 1430m/s and iron the speed is about 5130m/s speed of sound in a solid, depends on (i) temperature and (ii) the direction and speed of the wind. For every 1^0C rise in temperature, the speed of sound in air increase by about 0.6m/s, that is if the speed of sound is 330m/s at 30^0C, the speed increases to 330.6m/s when temperature rises to 31^0C.

STEP III :- Students with practical activity using inquiry differences between music and noise. Sound waves may be classified as musical notes or noise. A musical note is generated from sources, which vibrate with regular frequency. Music al note (music) is pleasant to the human hearing. Hence, we enjoy it, dance to it and we are refreshed by it. Noise on the other hand emanates from sources vibrating with irregular frequencies. Noise is inpleasant and irritating. An example of noise is rattling sound produced when kids drag metals or cans on a concrete floor. The following are characteristics of a musical notes Pitch, Intensity loudness and quality (or Timbre).

STEP IV:- Discussion by students based on the findings about sound wave concepts of physics examples musical instruments, sound absorption and echo for their application and its working examples

STEPV:- The lesson evaluated by students and teacher response to students question based on the findings and discussionon sound wave concepts of physics example Define sound waves, mentioning the types of sound waves among others

CONCLUSION: The lesson concluded after the students haveanswered the question correctly.

WEEK FIVE

EXPERIMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: LIGHT WAVES

METHOD OF TEACHING: Inquiry Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define Light waves
2. Sources of light waves
3. Interaction of light with matter
4. Rectilinear propagation of light
5. Reflection of light at plane and curve surface

PREVIOUS KNOWLEDGE: Students have learnt about sound waves and type of sound waves etc

INTRODUCTION: The lesson introducesby asking students questions on previous knowledge example

1. Definition of sound waves?
2. Explain type of sound waves?

PRESENTATION: Students with guide of teacher presents the lesson with following steps

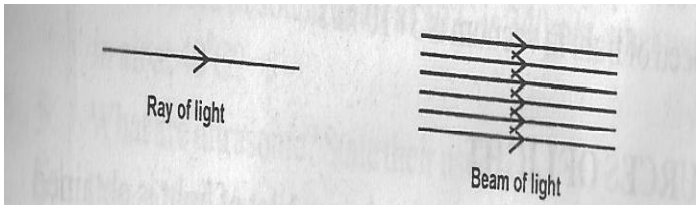
STEP I :- Students with the use of inquiry method identify the following

i.. Light waves : Ligth is a form of energy, which give usa sensation of vision, through light exhibits some particle nature, it is also a wave (electromagnetic wave). The speed of light in vacuum is 3×10^8m/s.

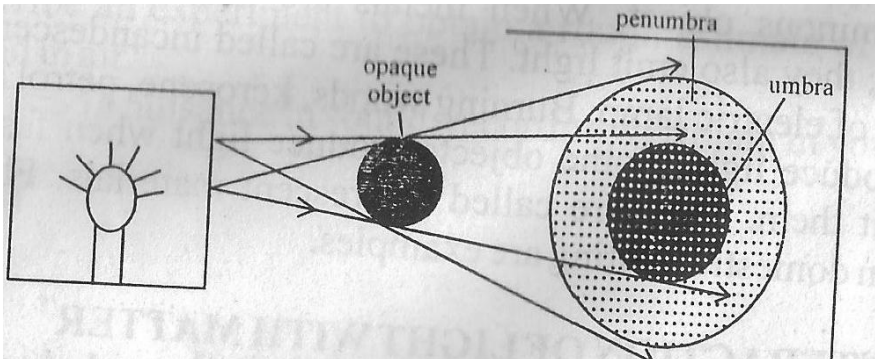
ii. Source of light: An object that emits light is said to be luminous. A lot of light is obtained from the sun. The stars are also source of light. The moon however, does not emit its own light; it only reflects the light of the sun. Hence the moon is not a luminous object. When metals are heated to a very high temperature, they also emit light. These are called incandescent object eg filament of electric lamp, burning woods, kerosene, petrol and gases can also produce light. Some object produce light when fast moving electrons hit them, they are called fluorescent materials. Fluorescent tubes used in domestic lighting are example.

iii. Interaction of light with matter: When light falls on matter, either it is absorbed, reflected or transmitted in practice. For instance, we can have both reflection and refraction from a surface, we can thus classify material according to whether they absorb, reflect or transmit light that fall on them as transparent, translucent and opaque materials. Example (a) transparent materials, these allow light to pass through them, that is they transmit light eg are plane glass, clean water etc note we can see through a transparent material. (b). translucent materials, these allow light to pass through but we cannot see through. (c). opaque materials, these do not transmit light at all, they absorb all light that fall on them eg wood, wall etc. when the direction of light change as it moves from one medium to another medium we call this refraction.

STEP II :- Students using inquiry method identify how rectilinear propagate of light waves using formation of shadows and eclipse. That is light travels in a straight line. Ray of light represents motion of light. A collection of rays of light is called beam of light.



Formation of shadows is evidence that light travels in a straight line. In the diagram below, beams of light fall on an opaque object arranged in a line with a screen. The opaque object prevents the ray from reaching the screen. Hence a shadow of the opaque object is formed on the screen. If light does not travel in a straight line, it would have bend around the opaque object to reach the screen. The opaque objects stands in its way and stop its motion towards the screen, thereby producing dark region (shadow) on the screen.



STEP III:- Students using method identify the reflection of light at plane and curved surfaces, laws of reflection, example the law of reflection are

- The incident ray, the reflected ray and the normal, at the point of incident all are the same plane
- The angle of incident is equal to the angle of reflection

STEP IV:- Students identify the application and its working of reflections of lightexamples using image in a plane mirror, inclined mirror, rotation of a plane mirror, reflection at curve mirrors location of image for different object position etc

STEP V:- Discussion by students based on the findings about light wave concepts of physics examples reflection of light at plane and curved surfaces, laws of reflection, application and its working examples

STEP VI:- The lesson evaluated by students and teacher response to students question based on the findings and discussionon light wave concepts of physics example Define light waves, reflection of light at plane and curved surfaces, laws of reflection, among others

CONCLUSION: The lesson concluded after the students haveanswered the questions correctly.

APPENDIX IV

LESSON PLAN FOR EXPERIMENTAL GROUP II (DEMONSTRATION)

WEEK ONE

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPAGATION AND REPRESRNTATION OF WAVES

METHOD OF TEACHING: Demonstration Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1. Identify and define waves
2. Propagation of waves
3. Representation of waves

PREVIOUS KNOWLEDGE: Students have learnt about Heat, Type of Heat example, Heat energy, Heat transfer etc

INTRODUCTION: The lesson introduces by asking studentsquestions on previous knowledge example

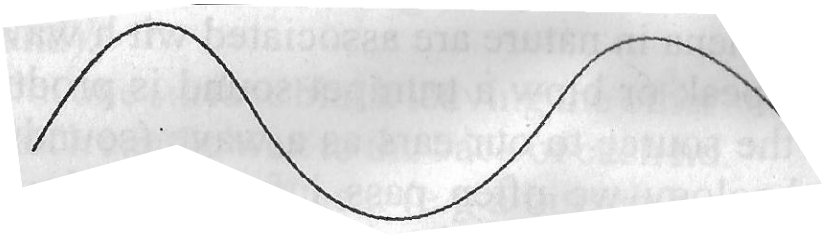
1. Who can define Heat?
2. Mention type of Heat
3. The topic would be introduced example propagation and representation of waves by define the term waves

PRESENTATION: The lesson presented in the following steps

STEP 1: Student with guide of the teacher demonstratesthe term waves. Example when we mention the word ‘wave’ your mind quickly goes to disturbance observed when stone is

dropped in to a pool of water, you are right think so. The disturbance that spread outwards from the point where the stone hits the water is called ripple that is the water waves. Wave is a disturbance which travels through a medium transferring energy from one point to another without causing any permanent displacement of the medium.

STEP 2: Students with good demonstration explained how waves were propagated example a. Fill a large basin with water. Place a piece of cork on the water surface at some distance from the center of the basin. Drop a piece of small stone form a height into the water. As the stone strike the water, observe the pattern of the disturbance produced. Also observe the motion of the cork. You will find out that circular disturbance spread outward from the point where the stone hits the water this is a water wave. Also you will notice that as the waves spread past the cork, the cork only bob up and down (oscillates) in the water. It does not travel with the medium. This show that the water molecule are not the one carrying energy from one point to another rather they vibrate about a fixed position b. for wave in a string tie a rope about 5m long to a rigid support (eg a vertical pole). Hold the other end of the rope and stand about 4m long a way from the rigid support so that the rope sags slightly. Now move the free end of the rope up and down, observe the wave moving through the rope. The up and down movement constitutes a disturbance at one end of the rope which is now propagated along the length of the rope.



STEP 3: Studentswith guide of the teacher demonstrate the parameter of waves such as amplitude, frequency f, period T, and speed of the wave (velocity; V).example a. in waves, there are usually ‘high’ and ‘low’ points. This is because a wave is a vibration. These point (‘high’ and ‘low’) repeat themselves at regular interval a long the wave motion. These ‘high’ and ‘low’ points are called crest and trough. For the wave described in the helical spring, we call the ‘high’ and ‘low’ point compression and rarefaction respectively. The distance between two successive crests or successive trough in a wave is called the wavelength of the wave b. since a wave involve vibration, there is various position of displacement of the particle of the medium from their rest position. The maximum displacement from the position of rest is called amplitude. The S.I unit is metre (m). For convenience, however, amplitude may be expressed in cetimetre (cm) and millimeters(mm). c. period is the time taken for one complete oscillation of a wave is called its period. It then means that period is the reciprocal of frequency i.e T =i/f d. wave velocity (speed), v is the distance travelled by a wave in a time of one second in a

medium. While frequency refer to the number of to and fro – motion (oscillation) of a wave per second.etc

STEP 4:- Discussion by students based on the findings about propagation and representation of waves concepts of physics

STEP5: The lesson evaluated by students and teacher response to students questions based on the findings and discussion on the wholeconcept of waves example that is Definition, parameters of waves, propagation and representation of the waves.

CONCLUSION: The lesson concluded after the students haveanswered the question correctly.

WEEK TWO

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: TYPE OF WAVES

METHOD OF TEACHING: Demonstration Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1. Define waves
2. Mention type of waves
3. Explain the type of waves

PREVIOUS KNOWLEDGE: Students have learnt about Definition of waves, propagation of waves and representation of waves etc

INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

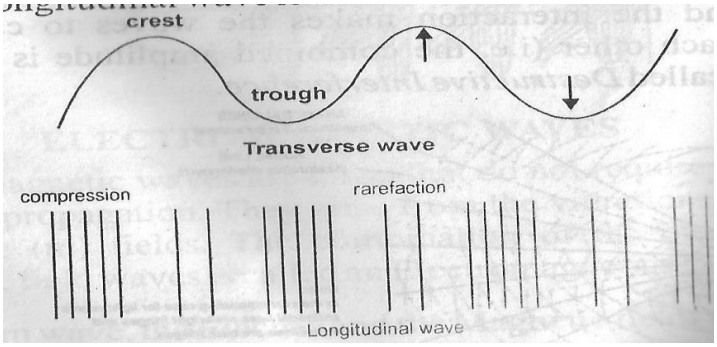
1. Who can define waves?
2. Explain propagation of waves
3. Draw the representation of waves
4. The topic would be introduced by mentioning the type of waves

PRESENTATION: The lesson presented in the following steps

STEP 1: i. Students with guide of teacher demonstrationthe type of waves example: Mechanical waves, Electromagnetic waves, Transverse waves and longitudinal Waves that is:

1. Mechanical wave is a type of wave that required a material medium for their propagation that is they cannot travel through vacuum. Mechanical also involve water waves, sound waves, waves on a rope or string etc
2. Electromagnetic wave is the wave that can pass through vacuum. They do not require any material medium for propagation, they are especially useful in communication, electromagnetic wave which consists light waves, radio waves, x – ray and gamma raysetc
3. Transverse waves are waves in which the vibration of the particles of the is perpendicular to the direction of motion of the waves example all electromagnetic waves are transverse wave another example is water waves (ripple)

STEP 2: Students with guide by teacher demonstrate the wave motion process which involve in the transferring of disturbance which travels through a medium transferring energy from one point to another with out any transfer of particles of medium. Also a longitudinal wave is waves whose vibrations are parallel to the directions of motion that is wave in helical spring which having compression and rarefaction and sound wave is another example of longitudinal waves.



STEP3: Discussion on students' findings that is what students identify from difference type of waves Transverse waves and longitudinal waves

STEP4: The lesson evaluated by students and teacher to response to students questions based on the findings and discussion, mentioning the type of waves example the Mechanical waves, Electromagnetic waves, Transverse waves and longitudinal waves.differentiation between those two waves.

CONCLUSION: The lesson concluded after the students haveanswered the question correctly.

WEEK THREE

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPERTIES OF WAVES

METHOD OF TEACHING: Demonstration Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to

1. Define waves
2. Mention the properties of waves
3. Explain the properties of waves

PREVIOUS KNOWLEDGE: Students have learnt about type of waves etc

INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

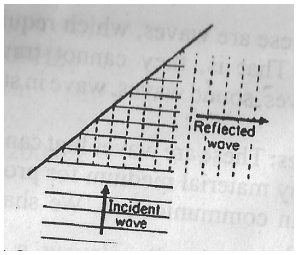
1. Who can mention any two types of wave?
2. Explain mention any two types of wave?
3. The topic would be introduced by mentioning the properties of waves

PRESENTATION: The lesson presented in the following steps

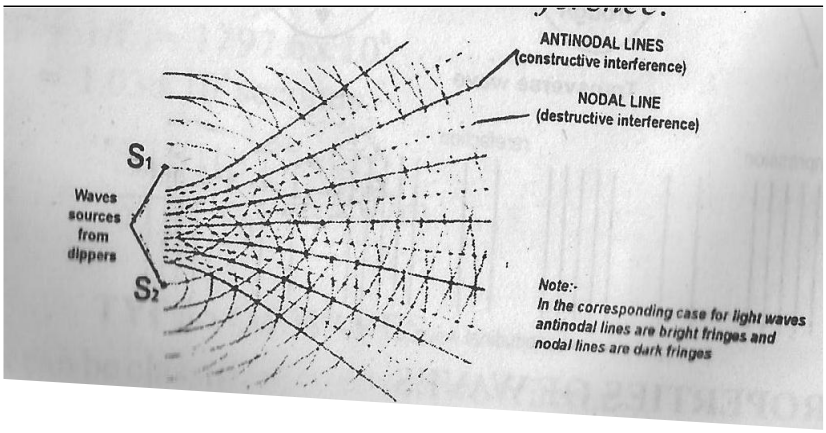
STEP 1: Students with guide of teacher using demonstration method drawthe properties of waves that is Reflection, Refraction, Interference, Diffraction and Polarization example Refraction are the change in speed and direction of the waves as they cross the boundary that when a wave moves from one medium to another, its direction may change at the boundary between the two medium. The change in direction is due to change in wave

velocity as it passes from one medium to another. A straw dipped in a glass of water appears bent due to refraction of light when it passes from air to water also when one looks into a deep pool; it appears shallow because of refraction of light.

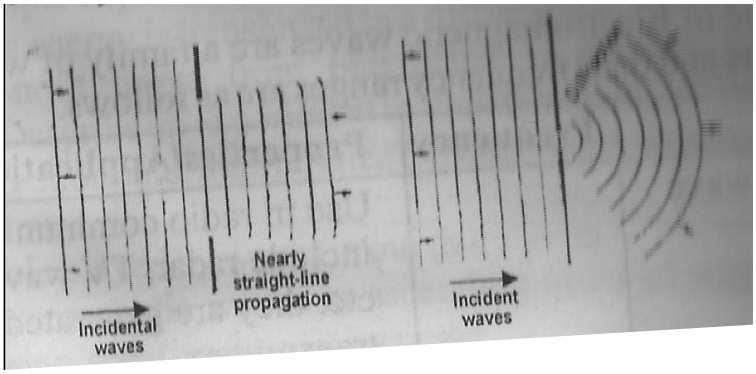
B. Reflection when waves meet a barrier in its path, it turns back. This is called reflection that is all waves exhibit reflection, the production of echo is due to reflection of sound waves, the formation of image in a mirror is due to reflection of light waves.



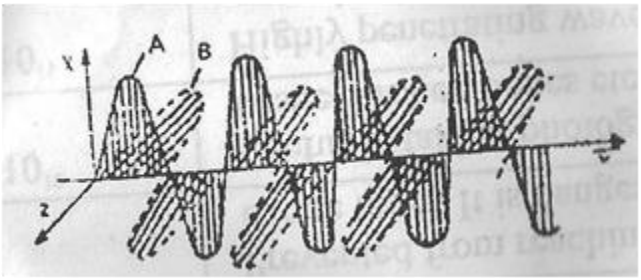
C. Interference when two waves moving along different path meet and interact, interference takes place. There are two types of interference; if when the two waves interact they re – enforce each other (ie the combined amplitude is greater than any one of the two waves) the interaction is called constructive interference and if on the other hand the interaction makes the waves to cancel out (neutralize) each other (ie the combined amplitude is zero) the interaction is called Destructive interference.



STEP3: Students with good demonstration differentiate between the diffraction and polarization of waves that is diffraction is the ability of a wave to bend around the edge of an obstacle or spread around a small opening (aperture). Diffraction of a wave depend on the size of the aperture relative to the wavelength of the wave for example doors and windows are big aperture that can cause the diffraction of sound waves, but to cause the diffraction of light waves, diffraction of light requires very small aperture because the wavelength of the light is very small.



The polarization not all waves exhibit polarization but only transverse waves exhibit polarization. We said earlier that in transverse a wave the vibration is perpendicular to its direction of motion. These vibrations take place along all axes in planes perpendicular to the direction of motion. If a device (means) can now cuff – off all vibration in all axes except one, then we say that the waves is polarized. That is vibration along one axes is perpendicular to its direction of motion and there are no other vibrations in any axis



STEP3: Discussion by students based on the findings about properties of wavesexample Reflection, Refraction, Interference, Diffraction and Polarization.

STEP4: The lesson evaluated by students and teacher response to students question based on the findings and discussion on Reflection, Refraction, Interference, Diffraction and Polarization. Example i. mention any two properties of wave ii. Who explain difference between those two properties of waves.

CONCLUSION: The lesson concluded after the students haveanswered the question correctly.

WEEK FOUR

EXPERIEMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: SOUND WAVES

METHOD OF TEACHING: Demonstration Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define sound waves
2. Types of sound waves

PREVIOUS KNOWLEDGE: Students have learnt about waves and properties of waves etc

INTRODUCTION: The lesson would be introduces his lesson by asking students questions on previous knowledge example

i. Definition of waves?
ii. Explain any two properties of waves?

PRESENTATION: Students with guide of the teacher presents the lesson with following steps

STEP I :- Students using demonstration method defined explained the term sound waves that is,

i. Sound waves: sound waves are generated whenever a body vibration mechanically in the frequency range of 20Hz to 20,000 Hz. Thus guitar string, membrane of a drum, or a bell, vibrates, sound wave are produced. The sound waves can be perceived by human ear. Hence the frequency of 20Hz to 20,000 Hz is called audible sound (audio frequency).

When a body vibrates with a frequency greater than 20,000 Hz, the sound produced cannot be detected by human hearing organ. Hence, we call such sound ultrasonic and the uses of ultrasonic waves are:

a. used in medicine to detect pregnancy, locate kidney stones etc and some other diagnosis

b. used in cleaning fabric and delicate instruments like watches

c. used to sterilize medical equipment, water etc

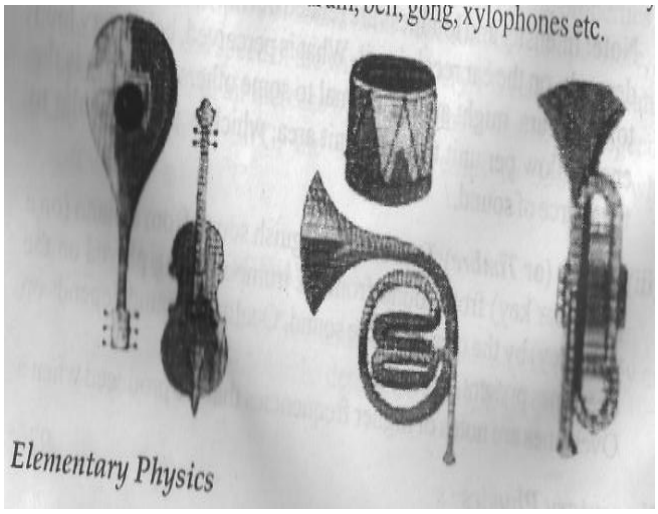
d. used to detect flaws in metals

ii. propagation of sound waves:

STEP II:-Students with guide of the teacher explains using good demonstration the musical instruments, sound absorption and echo example musical instrument are designed to produce pleasant, soothing or enjoyable sound. We can classify them into (i) wind instruments: these instrument produce sound by vibration of air column in a tube example include flutes, pipe organ, trumpet, trombone etc

(ii) string instruments; these produce sound by vibration of the light of a stretched string. Frequency of vibration of string depends on length; mass per unit length and the stretching force in the string example are guitar, piano, sonometer, violin etc

(iii) percussion instruments: these are instruments, which produce sound by vibration when they are struck or hit examples are drum, bell, gong, xylophones etc



STEP III:- Students using demonstration method explains application of sound waves and its working examples sound absorption: concert halls or lecture rooms or broadcasting studio need to have special acoustic (sound) design. If not, sound is reflected from the walls, ceiling or floors and this can disturb the sound from an orchestra or a speaker which reaches the audience. To absorb the sound from the surface, suitable tiles of plastic or cork or other porous materials are used to cover the walls and other surface in concrete halls or studio. Sound waves are absorbed by the human body, so the cushion absorbs the sound when the room is not full of people. And echowhen a sound wave travelling encounters a hard surface such as walls, rock etc it is reflected. Thus, when a sound is produced in a large empty hall or near a cliff, the sound is heard over and over again. This sound repeats it self over a short time is called echo. The following are the application of echo (i) approximate determination of speed of sound (ii) echo sounding (iii) mineral exploration (iv) radar system.

STEP IV: Students calculate and measure following example:

(i) A bat emits sound at speed 15m/s and receives the echoes 0.5 second later. Calculate the distance of the bat from the reflector. Solution $d = v \times t / 2 = 150 \times 0.5 / 2 = 37.5m/s$.

(ii) A boy standing 95m from the foot of a tall cliff claps his hands and hears an echo 0.6 second later. Calculate the speed of sound in air. Solution $V = 2d / t = 2 \times 95 / 0.6 = 320m/s$

STEP V:- Discussion by students based on the findings about sound wave concepts of physics examples musical instruments, sound absorption and echo for their application and its working examples

STEPVI:- The lesson evaluated by students and teacher response to students question based on the findings and discussion on sound wave concepts of physics example Define sound waves, mentioning the types of sound waves among others

CONCLUSION: The lesson concluded after the students haveanswered the questions correctly.

WEEK FIVE

EXPERIMENTAL GROUP (EG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: LIGHT WAVES

METHOD OF TEACHING: Demonstration Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define Light waves
2. Sources of light waves
3. Interaction of light with matter
4. Rectilinear propagation of light
5. Reflection of light at plane and curve surface

PREVIOUS KNOWLEDGE: Students have learnt about sound waves and type of sound waves etc

INTRODUCTION: The lesson introduces by asking students questions on previous knowledge example

1. Definition of sound waves?
2. Explain type of sound waves?

PRESENTATION: The lesson presented with following steps

STEP I:- Students with guide of the teacherdefine the term light wave using demonstration method by given different examples:

i.. Light waves : Light is a form of energy, which give usa sensation of vision, through light exhibits some particle nature, it is also a wave (electromagnetic wave). The speed of light in vacuum is 3×10^8m/s.

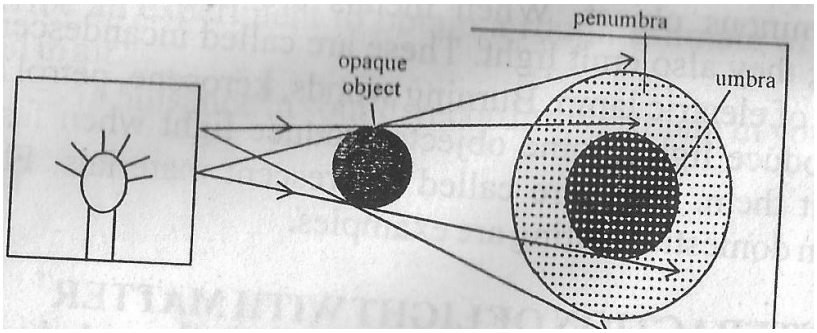
ii. Source of light: An object that emits light is said to be luminous. A lot of light is obtained from the sun. The stars are also source of light. The moon however, does not emit its own light; it only reflects the light of the sun. Hence the moon is not a luminous object. When metals are heated to a very high temperature, they also emit light. These are called incandescent object eg filament of electric lamp, burning woods, kerosene, petrol and gases can also produce light. Some object produce light when fast moving electrons hit them, they are called fluorescent materials. Fluorescent tubes used in domestic lighting are example.

iii. Interaction of light with matter: When light falls on matter, either it is absorbed, reflected or transmitted in practice however, more than one of these occur at the same time. For instance, we can have both reflection and refraction from a surface, we can thus classify material according to whether they absorb, reflect or transmit light that fall on them as transparent, translucent and opaque materials. Example (a) transparent materials, these allow light to pass through them, that is they transmit light eg are plane glass, clean water etc note we can see through a transparent material. (b). translucent materials, these allow light to pass through but we cannot see through. (c). opaque materials, these do not transmit light at all, they absorb all light that fall on them eg wood, wall etc. when the direction of light change as it moves from one medium to another medium we call this refraction.

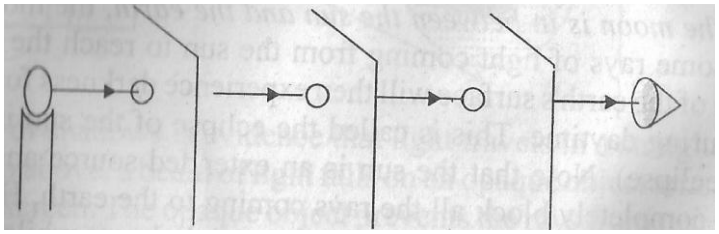
STEP II :- Students vusing demonstration method explain rectilinear propagation of light waves by given the example of formation of shadows and eclipse. That is light travels in a straight line. Ray of light represents motion of light. A collection of rays of light is called beam of light.



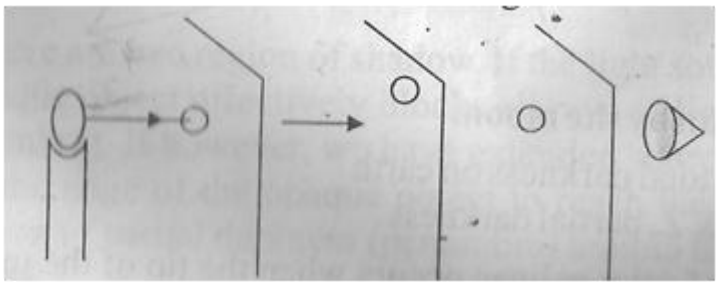
Formation of shadows is evidence that light travels in a straight line. In the diagram below, beams of light fall on an opaque object arranged in a line with a screen. The opaque object prevents the ray from reaching the screen. Hence a shadow of the opaque object is formed on the screen. If light does not travel in a straight line, it would have bend around the opaque object to reach the screen. The opaque objects stands in its way and stop its motion towards the screen, thereby producing dark region (shadow) on the screen.



The students further demonstrate that light travels in a straight line with following experiment. Make a hole in three card board papers. Arrange the cardboard so that all the three are straight line. You can pass a string through the holes. The cardboard will be well spaced from each other. Place a source of light (eg torchlight at one end close to first hole and position the eye at the other end close to the third hole). You will see the ray of light from the source passing through the holes in a straight line



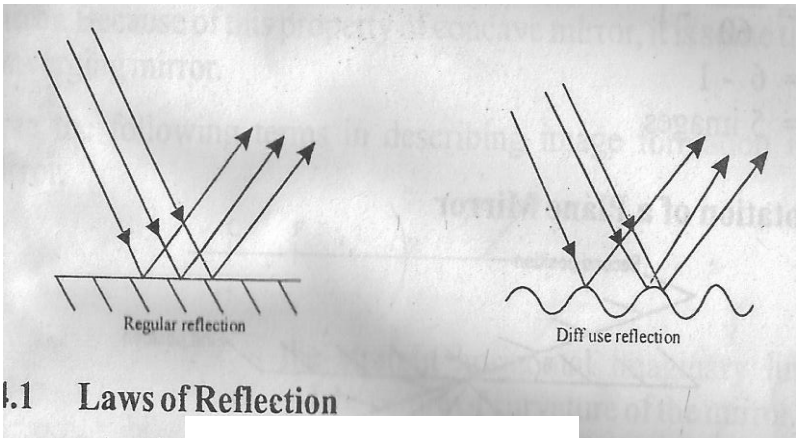
Again displace the cardboard in the middle to one side so that its hole is no longer in a straight line with the others. Repeat the experiment as stated above. You will observe that the ray of light has been cut – off by the second card board the eye can not see ray of light through the third hole. This shows that light in a straight line



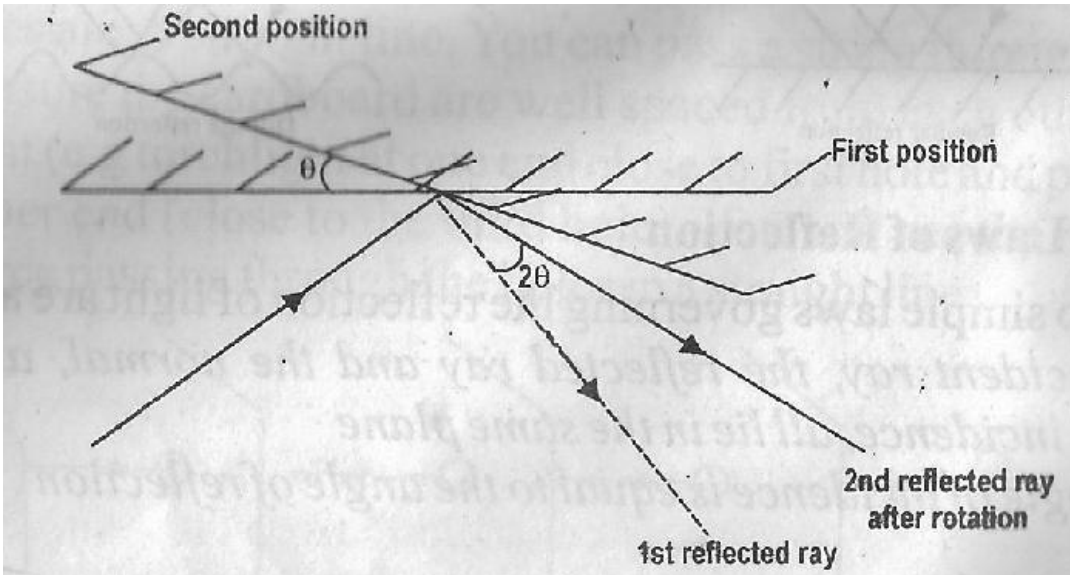
STEP III:- Students with guide of the teacher using demonstration methodexplains reflection of light at plane and curved surfaces, laws of reflection, example the following are the laws of reflection of light.

- The incident ray, the reflected ray and the normal, at the point of incident all are the same plane
- The angle of incident is equal to the angle of reflection

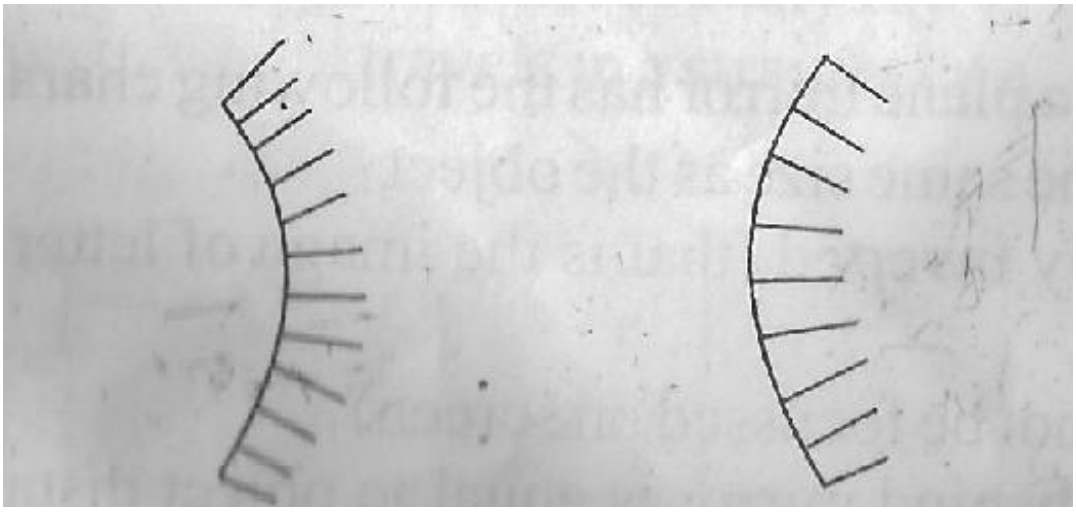
STEP IV:- Students with guide of the teacher using demonstration methodexplains application and its working of reflections of light examples using image in a plane mirror, inclined mirror, rotation of a plane mirror, reflection at curve mirrors location of image for different object position etc. example light as a exhibit wave property of reflection. When light falls on a polished surface, it is reflected in a direction depending on the angle at which it strikes the surface. There two type of reflection, regular and diffuse. Regular reflection take place when light falls on smooth surface. In diffuse reflection, the rays are surface after reflection. The reflected rays are scattered after reflection if the incident ray were parallel, the reflected rays will no longer be parallel. Diffuse reflected occurs when light falls on rough or uneven surface.



Example1. Rotation of a plane mirror is when the mirror is rotate through an angle. Keeping the incident ray in its position; the reflected ray will be rotated through an angle 2 θ



2. Reflection at curved mirror: There are types of curved mirror. These are concave and convex mirrors. Because these curved mirrors are part of a sphere we call them spherical mirror.



STEP V:- Discussion by students based on the findings about light wave concepts of physics examples reflection of light at plane and curved surfaces, laws of reflection, application and its working examples

STEP VI:- The lesson evaluated by students and teacher response to students question based on the findings and discussion on light wave concepts of physics example Define

light waves, reflection of light at plane and curved surfaces, laws of reflection, among others

CONCLUSION: The lesson concluded after the students haveanswered the questions correctly.

APPENDIX V

LESSON PLAN FOR CONTROL GROUP (LECTURE METHOD)

WEEK ONE

CONTROL GROUP (CG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPAGATION AND REPRESRNTATION OF WAVES

METHOD OF TEACHING: Lecture Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container eg booklet, small stone, water, cardboard paper, marker of three different colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1.Identify and define waves

2. Propagation of waves

3. Representation of waves

PREVIOUS KNOWLEDGE: Students have learnt about Heat, Type of Heat example, Heat energy, Heat transfer etc

INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

1. Who can define Heat?
2. Mention type of Heat
3. The topic would be introduced example propagation and representation of waves

PRESENTATION: The lesson would be presented in the following steps

STEP 1: The teacher define waves concept to the student

STEP 2:The teacher explaining of how waves would be propagation with practical demonstration of the concept waves

STEP 3: The teacher explaining the parameter of waves such as amplitude, frequency f, period T, and speed of the wave (velocity; V).

SUMMARY: The lesson would be summarized by explaining the whole concept of waves that is Definition, propagation and representation of the waves

CONCLUSION: The lesson would be concluded after the students have answered the question correctly.

LESSON NOTES: Notes would be given to the students on the above concept.

WEEK TWO

CONTROL GROUP (CG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: TYPE OF WAVES

METHOD OF TEACHING: Lecture Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colours example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to:

1. Define waves
2. Mention type of waves
3. Explain the type of waves

PREVIOUS KNOWLEDGE: Students have learnt about propagation of waves and representation of waves etc

INTRODUCTION: The lesson would be introduced by asking students questions on previous knowledge example

1. Who can define waves?
2. Explain propagation of waves
3. Draw the representation of waves
4. The topic would be introduced by mentioning the type of waves

PRESENTATION: The lesson presented in the following steps

STEP 1: i. explaining the type of waves example: Mechanical waves, Electromagnetic waves Transverse waves and longitudinal waves

SUMMARY: The lesson would be summarized by explaining the type of waves example the Mechanical waves, Electromagnetic waves Transverse waves and longitudinal waves.

CONCLUSION: The lesson would be concluded by asking question to the students' example;

i. who can mention any two type of waves,

ii. Who can explain difference between those two waves.

LESSON NOTES: Notes would be given to the students on the above concept.

WEEK THREE

CONTROL GROUP (CG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: PROPERTIES OF WAVES

METHOD OF TEACHING: Lecture Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students should able to

1. Define waves
2. Mention the properties of waves
3. Explain the properties of waves

PREVIOUS KNOWLEDGE: Students have learnt about type of waves etc

INTRODUCTION: The lesson introduced by asking students questions on previous knowledge example

1. Who can mention any two types of wave?
2. Explain mention any two types of wave?
3. The topic would be introduced by mentioning the properties of waves

PRESENTATION: The lesson presented in the following steps

STEP 1: i. Teacher explained the properties of waves example: Reflection,

Refraction, Interference, Diffraction and Polarization

SUMMARY: The lesson would be summarized by explaining the properties of wave's example Reflection, Refraction, Interference, Diffraction and Polarization.

CONCLUSION: The lesson would be concluded by asking question to the students example;

i. who can mention any two properties of waves,

ii. Who can explain difference between those two

properties of waves.

LESSON NOTES: Notes would be given to the students on the above concept.

WEEK FOUR

CONTROL GROUP (CG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: SOUND WAVES

METHOD OF TEACHING: Lecture Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define sound waves
2. Types of sound waves

PREVIOUS KNOWLEDGE: Students have learnt about waves and properties of wavesetc

INTRODUCTION: The lesson would be introduces his lesson by asking students questions on previous knowledge example

1. Definition of waves?
2. Explain any two properties of waves?

PRESENTATION: The teacher presents the lesson with following steps

STEP I :- The teacher defined

i. sound waves
ii. propagation of sound waves

STEP II :- The teacher explain ultrasonic waves and gives the differences between music and noise.

STEP III:- The teacher explains musical instruments, sound absorption and echo

STEP IV:- The teacher explains application and its working examples

SUMMARY AND CONCLUSION: The teacher summarized and concluded his lesson by given some class works and goes round to assist the students

WEEK FIVE

CONTROL GROUP (CG):

SUBJECT: PYHSICS

CLASS: SSII

TOPIC: LIGHT WAVES

METHOD OF TEACHING: Lecture Method

TIME: 45MINUTE

SEX: MALE & FEMALE

REFERENCE BOOK: SS II PHYSICS BY P.N OKEKE

INTRUCTIONAL MATERIAL: Chalkboard, larger container e.g booklet, small stone,

water, cardboard paper, marker of three different

colour example Blue, Red and Black

BEHAVIUORAL OBJECTIVES: By the end of the lesson, students would be able to

1. Define Light waves
2. Sources of light waves
3. Interaction of light with matter
4. Rectilinear propagation of light
5. Reflection of light at plane and curve surface

PREVIOUS KNOWLEDGE: Students have learnt about sound waves and type of Sound waves etc

INTRODUCTION: The lesson would be introduces his lesson by asking students questions on previous knowledge example

1. Definition of sound waves?
2. Explain type of sound waves?

PRESENTATION: The teacher presents the lesson with following steps

STEP I :- The teacher defined

i. Light waves
ii. Source of light
iii. Interaction of light with matter

STEP II :- The teacher explain rectilinear propagation of light waves and gives the evidence of rectilinear of light example formation of shadows and eclipse.

STEP III:- The teacher explains reflection of light at plane and curved surfaces, laws of reflection, example the reflection laws are as follows

- The incident ray, the reflected ray and the normal, at the point of incident all are the same plane
- The angle of incident is equal to the angle of reflection

STEP IV:- The teacher explains application and its working of reflections of light examples using image in a plane mirror, inclined mirror, rotation of a plane mirror, reflection at curve mirrors location of image for different object position etc

SUMMARY AND CONCLUSION: The teacher summarized and concluded his lesson by given some class works and goes round to assist the students

APPENDIX VI

ATITUDE QUESTIONNAIRE TOWARD PHYSICS EDUCATION

INSTRUCTION:

Following are statement which intended to measure your attitude toward physics education. Please read each statement and mark your response in the response sheet by putting an 'x' mark in the circle indicating your choice. The description of the choice is as follows:

Strongly Agree (SA)

Agree (A)

Undecided (U)

Disagree (D)

Strongly Disagree (SD)

SECTION A: PERSONAL INFORMATION

Name of School ----------

Class ----------

Gender: Male [ ] Female [ ]

Age ----------

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

S/N	STATEMENT	SA	A	U	D	SD
1	I am sure that I can learn physics education					
2	My teacher have been interested in my progress in physics education					
3	Knowing physics education will help me earn a living					
4	I don't think I could do advance physics education					
5	Physics education will not be important to me in my life's work					
6	Males are not naturally better than females in physics education					
7	Physics education is hard for me					
8	It's hard to believe a female could be a genius in physics education					
9	I need physics education for my future work					
10	When a women has to solve a waves concept problems, she should ask a man for help					
11	I am sure of my self when I do physics education					
12	I don't expect to use much physics education when I get out of school					
13	Women can do just as well as men in physics education					
14	I'm not the type to do in physics education					
15	Physics education is a worthwhile, necessary subject					
16	My teacher have encouraged me to study more physics education					
17	Taking physics education is a waste of time					
18	I have a hard time getting teachers to talk seriously with me about physics education					
19	Female are as good as male in physics education					
20	I see physics education as something I won't use very often when I get out of the high school					
21	I feel that physic teacher ignore me when I try to talk about something serious					
22	I can get good grade in physics education					
23	I'll need a good understanding of physics education for my future work					
24	I would expect a women scientist to be a forceful type of person					
25	I know I can do well in physics education					
26	My teacher want me to take all the science I can					
27	My teachers would not take me seriously if I told them I was interested in a career in physics education and mathematics					
28	I study physics education because I know how useful it is					
29	Physics teachers have made me feel I have the ability to go on in physics education					
30	I would trust a female just as much as I would trust a male to solve important physics education problems					

Adapted from Fennema Sherman Attitude Scale

APPENDIX VII
RELIABILITY OF (PPT) INSTRUMENT FOR THE PILOT TEST

N	X	Y	X^2	Y^2	XY
1.	30	34	900	1156	102
2.	20	25	400	625	500
3.	25	30	625	900	750
4.	40	41	1600	1681	1640
5.	33	35	1089	1225	1155
6.	41	43	1681	1849	1763
7.	32	35	1024	1225	1120
8.	35	37	1225	1369	1295
9.	20	28	400	784	560
10.	10	17	100	289	170
11.	17	28	289	784	476
12.	22	30	484	900	660
13.	42	45	1764	2025	1890
14.	23	33	529	1089	759
15.	37	40	900	1024	1480
16.	23	25	1444	1600	575
17.	30	32	625	729	960
18.	38	40	961	1156	1520
19.	25	27	1521	1764	675
20.	31	34	324	441	1054
21.	39	42	484	576	1638
22.	18	21	961	1089	378
23.	22	24	729	900	528
24.	31	33	361	529	1023
25.	27	30	676	784	810
26.	19	23	361	529	437
27.	26	28	676	784	728
28.	30	34	900	1156	1020
29.	40	43	1600	1849	1720
30.	29	36	841	1296	1044
31.	50	55	2500	3025	2750
32.	47	47	2209	2209	2209
33.	35	46	1225	2116	1610
34.	49	55	2401	3025	2695
35.	37	43	1369	1849	1591
36.	20	26	400	676	520
37.	37	41	1369	1681	1517
38.	10	20	100	400	200
39.	23	24	529	576	552
40.	19	30	361	900	570
41.	55	60	3025	3600	3300
42.	36	55	1296	3025	1980
43.	21	40	441	1600	840
44.	18	32	324	1024	576
45.	09	20	81	400	180
46.	33	15	1089	225	495
47.	20	20	400	400	400
48.	39	25	1521	625	975
49.	17	31	289	961	527
50.	10	28	100	784	280
	$\sum X=1440$	$\sum Y=1686$	$\sum X^2=48364$	$\sum Y^2=62020$	$\sum XY=51397$

Where:

n = Total number of student for the pilot test (50)

X= test

Y= retest

$\sum X = 1440$ (sum of test)

$\sum Y = 1686$ (sum of retest)

$\sum X^2 = 48364$ (sum of sq of test)

$\sum Y^2 = 62020$ (sum of sq of retest)

$\sum XY = 51397$ (sum of test and retest

RELIABILITY

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded	0	.0
	Total	50	100.0

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

Reliability Statistics

Cronbach's Alpha	N of Items
.899	2

CORRELATIONS

		Test	Re-test
Test	Pearson Correlation	1	.818**
	Sig. (2-tailed)		.000
	N	50	50
Re-test	Pearson Correlation	.818**	1
	Sig. (2-tailed)	.000	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix VIII:

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded[a]	0	.0
	Total	50	100.0

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

Reliability Statistics

Cronbach's Alpha	Part 1	Value	.773
		N of Items	15[a]
	Part 2	Value	.752
		N of Items	15[b]
	Total N of Items		30
Correlation Between Forms			.941
Spearman-Brown Coefficient	Equal Length		.970
	Unequal Length		.970
Guttman Split-Half Coefficient			.966

a. The items are: VAR00001, VAR00002, VAR00003, VAR00004, VAR00005, VAR00006, VAR00007, VAR00008, VAR00009, VAR00010, VAR00011, VAR00012, VAR00013, VAR00014, VAR00015.

b. The items are: VAR00016, VAR00017, VAR00018, VAR00019, VAR00020, VAR00021, VAR00022, VAR00023, VAR00024, VAR00025, VAR00026, VAR00027, VAR00028, VAR00029, VAR00030.

Summary Item Statistics

		Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	Part 1	4.601	4.420	4.760	.340	1.077	.012	15[a]
	Part 2	4.639	4.420	4.760	.340	1.077	.012	15[b]
	Both Parts	4.620	4.420	4.760	.340	1.077	.012	30

a. The items are: VAR00001, VAR00002, VAR00003, VAR00004, VAR00005, VAR00006, VAR00007, VAR00008, VAR00009, VAR00010, VAR00011, VAR00012, VAR00013, VAR00014, VAR00015.

b. The items are: VAR00016, VAR00017, VAR00018, VAR00019, VAR00020, VAR00021, VAR00022, VAR00023, VAR00024, VAR00025, VAR00026, VAR00027, VAR00028, VAR00029, VAR00030.

Page 1

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR00001	134.0600	62.221	.392	.	.878
VAR00002	133.9800	61.204	.600	.	.873
VAR00003	134.1800	62.069	.311	.	.882
VAR00004	134.0600	62.343	.457	.	.876
VAR00005	133.9000	62.214	.551	.	.875
VAR00006	133.8400	62.627	.531	.	.875
VAR00007	133.9200	63.544	.373	.	.878
VAR00008	133.9400	63.241	.445	.	.877
VAR00009	134.0800	63.912	.281	.	.880
VAR00010	133.8400	63.933	.397	.	.878
VAR00011	134.0600	62.221	.392	.	.878
VAR00012	133.9800	61.204	.600	.	.873
VAR00013	134.1800	62.069	.311	.	.882
VAR00014	134.0600	62.343	.457	.	.876
VAR00015	133.9000	62.214	.551	.	.875
VAR00016	133.8400	62.627	.531	.	.875
VAR00017	133.9200	63.544	.373	.	.878
VAR00018	133.9400	63.241	.445	.	.877
VAR00019	134.0800	63.912	.281	.	.880
VAR00020	133.8400	63.933	.397	.	.878
VAR00021	134.0600	62.221	.392	.	.878
VAR00022	133.9800	61.204	.600	.	.873
VAR00023	134.1800	62.069	.311	.	.882
VAR00024	134.0600	62.343	.457	.	.876
VAR00025	133.9000	62.214	.551	.	.875
VAR00026	133.8400	62.627	.531	.	.875
VAR00027	133.9200	63.544	.373	.	.878
VAR00028	133.9400	63.241	.445	.	.877
VAR00029	134.0800	63.912	.281	.	.880
VAR00030	133.8400	63.933	.397	.	.878

```
DATASET ACTIVATE DataSet5.
SAVE OUTFILE='C:\Users\ebstar\Documents\assesmenr biochem.sav' /COMPRESSED.
```

APPENDIX IX

ITEMS ANALYSIS FOR PHYSICS PERFORMANCE TEST (PPT)

NO	Item difficulty index: P= R/T X 100	Item discrimination index: D = RU – RL / N	Decision
1.	041	0.43	Retained
2.	50	0.45	Retained
3.	55	0.43	Retained
4.	44	0.41	Retained
5.	39	0.29	Modified and Retained
6.	40	0.39	Modified and Retained
7.	41	0.48	Retained
8.	41	0.42	Retained
9.	38	0.31	Retained
10.	29	0.29	Modified and Retained
11.	29	0.28	Modified and Retained
12.	42	0.35	Retained
13.	29	0.29	Modified and Retained
14.	41	0.45	Retained
15.	40	0.42	Retained
16.	61	0.48	Retained
17.	40	0.53	Retained
18.	21	0.31	Modified and Retained
19.	31	0.29	Modified and Retained
20.	40	0.52	Retained
21.	38	0.40	Retained
22.	40	0.42	Retained
23.	42	0.58	Retained
24.	46	0.70	Retained
25.	39	0.31	Retained
26.	41	0.53	Retained
27.	46	0.51	Retained
28.	48	0.48	Retained
29.	46	0.50	Retained
30.	44	0.50	Retained
31.	51	0.50	Retained
32.	45	0.44	Retained
33.	50	0.43	Retained
34.	39	0.45	Retained
35.	44	0.45	Retained
36.	46	0.42	Retained
37.	44	0.48	Retained
38.	58	0.53	Retained
39.	44	0.57	Retained
40.	41	0.47	Retained
41.	48	0.48	Retained
42.	21	0.29	Retained
43.	53	0.53	Retained
44.	48	0.48	Retained
45.	38	0.37	Retained
46.	45	0.43	Retained
47.	36	0.50	Retained
48.	41	0.41	Retained
49.	47	0.47	Retained
50.	37	0.41	Retained

APPENDIX X
PRE TEST ANALYSIS FOR THE (PPT) INSTRUMENT

Descriptive statistic for pre-test score

Methodology	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Inquiry Method	150	35.7600	10.50387	.85764	34.0653	37.4547	10.00	56.00
Demonstration Method	150	34.5467	11.04693	.90198	32.7643	36.3290	10.00	56.00
Lecture Method	200	32.8000	10.81410	.76467	31.2921	34.3079	10.00	56.00
Total	500	34.2120	10.84316	.48492	33.2593	35.1647	10.00	56.00

ANOVA test for pre-test score

Group test	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	774.995	2	387.497	3.327	.037
Within Groups	57894.533	497	116.488		
Total	58669.528	499			

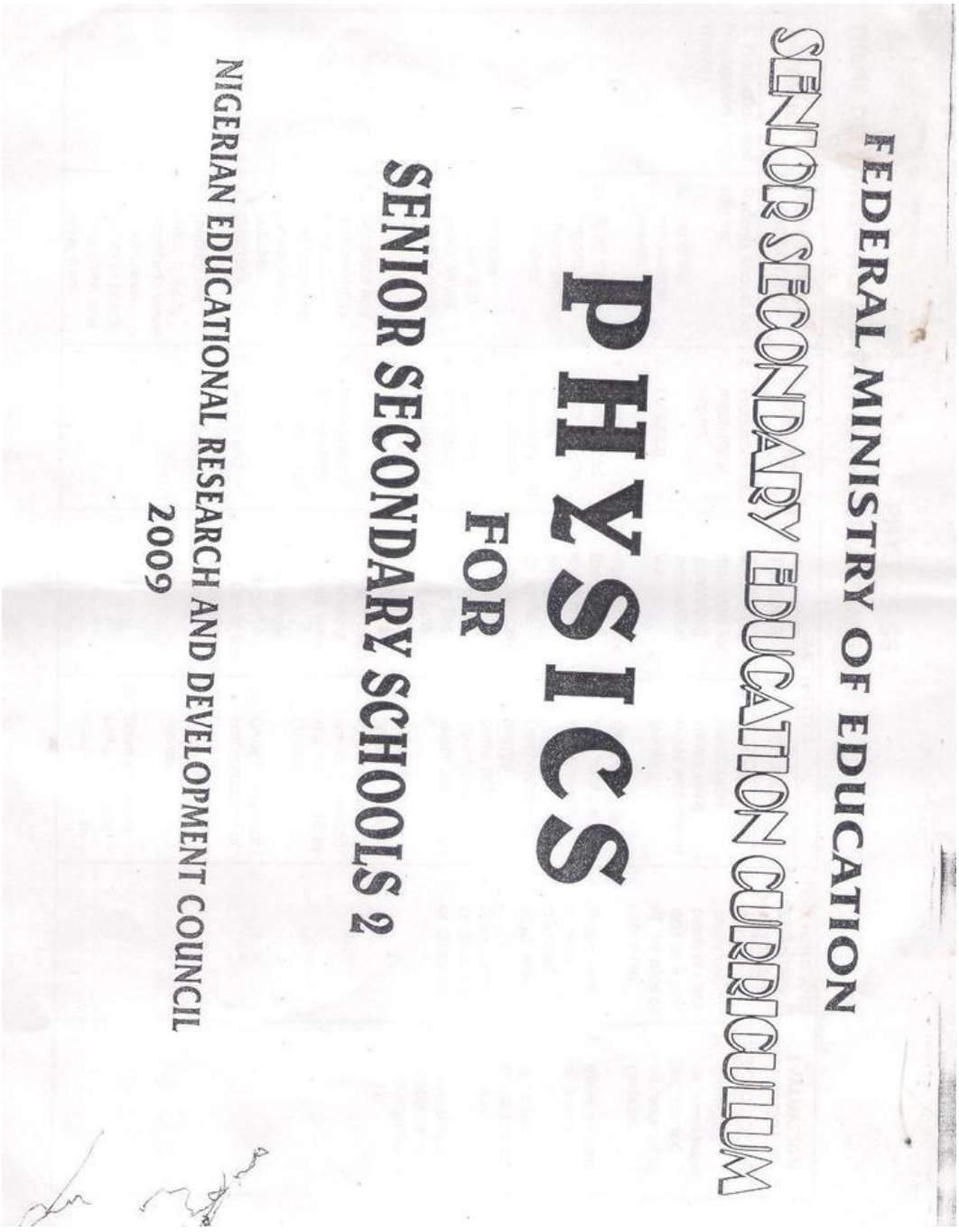
Multiple Comparisons

ScheffeTest

(I) Grouping variable	(J) Grouping variable	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Inquiry Method	Demonstration Method	1.21333	1.24626	.623	-1.8464	4.2731
	Lecture Method	2.96000*	1.16577	.041	.0979	5.8221
Demonstration Method	Inquiry Method	-1.21333	1.24626	.623	-4.2731	1.8464
	Lecture Method	1.74667	1.16577	.326	-1.1155	4.6088
Lecture Method	Inquiry Method	-2.96000*	1.16577	.041	-5.8221	-.0979
	Demonstration Method	-1.74667	1.16577	.326	-4.6088	1.1155

APPENDIX XI

SSII PHYSICS CURRICULUM USED FOR THE STUDY



FEDERAL MINISTRY OF EDUCATION

SENIOR SECONDARY EDUCATION CURRICULUM

PHYSICS

FOR

SENIOR SECONDARY SCHOOLS 2

NIGERIAN EDUCATIONAL RESEARCH AND DEVELOPMENT COUNCIL

2009

PHYSICS SS 2

THEME III: WAVES – MOTION WITHOUT MATERIAL TRANSFER

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
1. Production and Propagation of Waves	Students should be able to: 1. generate mechanical waves. 2. State the important characteristics of waves. 3. Produce circular and plane waves using a ripple tank. 4. Generate and demonstrate longitudinal and transverse waves using suitable materials. 5. Identify the crest, trough, amplitude wave length and points in phase on a given sine wave form.	1. Production of mechanical waves. 2. Pulsating system ♦ energy transmitted with definite speed, frequency and wavelength. 3. Wave form ♦ Description and graphical representation. 4. Mathematical relationships among f, λ, T and v. 5. Sound and light as wave phenomena.	1. Provide the materials for generating mechanical waves. 2. Demonstrate the use of ropes and slinky to generate mechanical waves. 3. Set up the ripple tank and demonstrate how it is used to generate various waves. 4. Give simple problems on the use of the wave equation $v = f\lambda$.	1. Generate mechanical waves using ropes and springs (slinky); 2. Use the ripple tank to show water waves. 3. Demonstrate energy propagation by waves using water waves. 4. Determine the speed of a wave by using the waves generated in a rope or slinky (spring). 5. Draw a graphical representation of transverse and longitudinal waves. 6. Solve problems using the wave equation $v = f\lambda$.	♦ Rope or slinky coil, piece of cloth tied on a part of the rope or slinky coil. ♦ Ripple tank or wide transparent bowl, water. ♦ Stop watch or clock, rope or slinky coil.	Students to: 1. distinguish between wave motion and vibration of particles. 2. identify forms of waves. 3. state the characteristics of waves. 4. solve simple problems using the equation $v = f\lambda$.

THEME III: WAVES – MOTION WITHOUT MATERIAL TRANSFER

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
	6. derive and use the relationship between wave velocity, frequency and wavelength. 7. Identify light as electro-magnetic waves.					
2. Types of Waves.	Students should be able to: 1. classify waves into longitudinal and transverse waves by using • mode of vibration • direction of propagation. 2. write down and explain the terms in the wave equation.	1. Longitudinal waves. 2. Transverse waves. 3. Wave equation $Y = A \sin (wt - \frac{2\pi x}{\lambda})$.	1. Provide rope and slinky to demonstrate transverse and longitudinal waves. 2. Explain the wave equation $Y = A \sin (wt - \frac{2\pi x}{\lambda})$. and the various terms.	Use the rope and the slinky to demonstrate transverse and longitrudinal waves.	• Rope or slinky.	Students to explain the terms in the wave equation and solve simple problems using the equestion.

PHYSICS SS 2

THEME III: WAVES – MOTION WITHOUT MATERIAL TRANSFER

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
3. Properties of Waves.	Students should be able to: 1. produce plane and circular waves using ripple tank. 2. Demonstrate the reflection of sound. 3. Demonstrate stationery waves. 4. Demonstrate reflection of heat radiation. 5. Demonstrate refraction of water waves and sounds.	1. Reflection of waves. ♦ Laws of reflection. 2. Superposition of waves. ♦ Two waves in the same direction (progresive wave) ♦ Two waves in opposite direction (standing or stationary waves) 3. Refraction of waves: ♦ Laws of refraction.	1. Set up the ripple tank to produce various waves. 2. Demonstrate reflection of sound from: ♦ Wrist watch by a reflector. ♦ Reflection of heat energy by a polished surface. 3. Lead the class to discuss properties of waves.	1. Use the ripple tank to produce wave forms. Students should draw the various patterns formed when waves are reflected. 2. Use the ray-box to trace incident and reflected rays of light. 3. Do experiments on refraction of light through: ♦ Glass prism ♦ Lenses.	♦ Ripple tank or wide transparent plastic bowl, thin horizontal bar ruler, water. ♦ Ray box, plane mirror or concave mirror, screen. ♦ Source of sound, reflector, hard surface. ♦ Source of heat, shiny surface or mirror, match stick or thermometer. ♦ Optical pin or big needle or office pin, glass block and triangular prism, drawing board. ♦ Ray box, convex lens, screen, metre rule.	Students to explain terms: reflection, refraction and superposition of waves.

THEME III: WAVES – MOTION WITHOUT MATERIAL TRANSFER

PHYSICS SS 2

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
4. Light waves.	Students should be able to: 1. list some light sources they come across in everyday life. 2. determine the angle of reflection for a given angle of incidence. 3. draw ray diagrams to show the formation of images by plane and curved mirrors; 4. explain some practical applications of plane and curved mirrors. 5. explain how the direction of light changes as it travels from one medium into the other.	1. Sources of light. 2. Light and matter. 3. Transmission of light. 4. Reflection of light at: ♦ Plane mirror surfaces ♦ Curved mirrors 5. Formation of images by ♦ Plane mirrors ♦ Curved mirrors 6. Laws of reflection. 7. Parabolic mirror as application of reflection of light on curved surfaces.	1. Lead a class discussion on the laws of reflection of light waves. 2. Demonstrate that the incident ray, the normal and the reflected ray all lie on the same plane. 3. Demonstrate the laws of refraction of light waves. 4. Demonstrate the relationship between u, v, and f in the mirror equation. 5. Demonstrate the formation of images at different points on the principal axis of mirrors and buses.	1. Show the laws of reflection by using a ray-box and a plane mirror. 2. Locate the image of an object behind a plane mirror. 3. Show by experiment that the incident ray, the normal and the reflected ray all lie on the same plane. 4. Locate image position by using curved mirror. 5. Investigate the relationship between u, v, and f – the mirror equation.	♦ Ray box, plane mirror. ♦ Optical pin, plane mirror ruler, drawing board. ♦ Ray box, concave mirror, screen, meter rule, converging lens. ♦ Ray box with illuminated object, rectangular glass block. ♦ Optical pin, rectangular glass block, drawing board. ♦ Drawing on chart board and using semicircular prism.	Students to: 1. state some applications of plane and curved mirrors. 2. solve simple problems on mirror formula. 3. explain refraction of light through rectangular glass block and triangular glass prism. 4. explain critical angle and total internal reflection and solve simple problems on them. 5. explain sun's radiation to the earth.

THEME III: WAVES – MOTION WITHOUT MATERIAL TRANSFER PHYSICS SS 2

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
	6. measure angles of incidence and refraction and hence deduce a value for the refractive index of a given material. 7. Explain the meaning of critical angle and total internal reflection stating the conditions under which they occur. 8. Establish the relationship between critical angle and refractive index, and apply it to the solution of simple problems.	7. Refraction of light through ♦ Rectangular glass block. ♦ Triangular prism 8. Laws of refraction. 9. Critical angle and total internal reflection. 10. Angle of deviation. 11. Dispersion of white light. 12. Sun's energy and the radiation to the earth. 13. Refraction of light through: ♦ Converging lenses. ♦ Diverging lenses.	6. Demonstrate how to obtain critical angle and total internal reflection; and assist students to relate them to the refractive index of glass or a medium. 7. Demonstrate the dispersion of light by a triangular glass prism. 8. Show film or pictures/charts on the effects of the sun"s radiation on the earth. 9. Demonstrate the relationship between object distance, image distance and the focal length of a lens.	6. Show formation of images at different points on the principal axis of mirrors and lenses. 7. Use the ray box to show the refraction of light through a rectangular glass block. 8. Vary the angles of incidence and obtain their corresponding angles of refraction and use this to establish Snell's law.	♦ Optical pin, drawing board, paper, incident angles between 5^0 and 25^0 using triangular prism. ♦ Triangular prism using incident angles between 30^0 and 70^0, optical pins, drawing board and paper. ♦ Triangular prism, source of light, screen. ♦ Pictures/ charts or film show on sun's radiation on the earth.	Students to solve simple problems applying the lens formula.

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
	9. Trace light rays through a triangular prism and obtain graphically the value of the angle of minimum deviation. 10. obtain the spectrum of white light. 11. describe the spectra of solar energy received by earth. 12. obtain images due to light rays through converging and diverging lenses using: ♦ ray tracks ♦ ray tracing method 13. use the lens formula to solve numerical problems on lenses.		10. Provide worked examples on problems on mirrors and lenses both graphically and analytically.	9. Show how critical angle and total internal reflrection are obtained and relate tem to the refractive index of glass or a medium 10. Use the expriment with the triangular prism to obtain minimum angle of deviation and show its relationship with the refractive index of glass. 11. Viewing of pictures/charts or film show on the effects of the sun's radiation on the earth. 12. Use the ray box to show the relationship between object distance, image distance and the focal length of a lens.	♦ Ray box, convex lens, screen, meter rule.	

TOPIC	PERFORMANCE OBJECTIVES	CONTENT	ACTIVITIES		TEACHING AND LEARNING MATERIALS	EVALUATION GUIDE
			TEACHER	STUDENT		
				13. solve problems on mirrors and lenses both graphically and analytically.		1.
5. Sound Waves	Students should be able to: 1. identify the vibrating sources when sound is produced. 2. distinguish between: ♦ Noise and music. ♦ Intensity and loudness. ♦ Pitch and frequency as applied to sound. 3. explain forced vibration and explain how it is used to amplify a sound.	1. Sources of sound. 2. Transmission of sound. 3. Noise and music. 4. Pitch, loudness and quality. 5. Forced virbation. ♦ Resonance ♦ Harmonics and overtones. 6. Speed of sound in: ♦ Solid ♦ Liquid ♦ Air	1. Demonstrate that sound does not travel in a vacuum by using the electric bell enclosed in a jar. 2. Demonstrate forced vibration with the resonance boxes and sonometer. 3. Demonstrate the determination of the speed of sound in air by using the resonance tube method or the sonometer.	1. Use resonance boxes and sonometer to illustrate forced vibration. 2. Determine the speed of sound in air by using the resonance tube method or the sonometer.	♦ Glass jar, electric bell, vacuum pump. ♦ Musical devices e.g. Radio cassette recorder, turning forks, resonance tube and sonometer. ♦ Helical spring (long) and long string. ♦ Sonometer.	Students to: 1. distinguish between noise and music. 2. Intensity and loudness, pitch and frequency. 3. Explain: ♦ Forced vibration ♦ Resonance.

APPENDIX XII

PRE-TEST, POST-TEST AND POST-POST TEST RESULT FOR EXPERIMENTALS AND CONTROL GROUPS

GOVERNMENT GIRLS SECONDARY SCHOOL WAILARI (DEMONSTRATION METHOD)

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	20	54	40	44.	22	56	70
2.	34	66	50	45.	34	64	56
3.	24	32	40	46.	40	64	60
4.	10	44	40	47.	44	60	56
5.	12	30	32	48.	38	58	56
6.	40	62	40	49.	36	60	58
7.	14	50	38	50.	42	70	56
8.	40	50	60	51.	34	58	50
9.	16	32	50	52.	48	60	54
10.	36	73	40	53.	34	64	58
11.	46	60	58	54.	44	68	60
12.	38	50	30	55.	36	54	58
13.	42	40	50	56.	42	68	60
14.	20	52	48	57.	40	68	58
15.	38	60	50	58.	34	68	52
16.	44	58	52	59.	36	72	68
17.	24	58	48	60.	36	60	58
18.	44	60	40	61.	42	58	50
19.	38	70	44	62.	50	80	62
20.	50	92	74	63.	14	44	40
21	42	40	40	64.	20	46	38
22	46	70	60	65	30	40	20
23.	34	50	52	66.	44	60	30
24.	10	42	40	67.	24	50	10
25.	38	48	50	68.	30	54	38
26.	36	60	64	69.	42	44	34
27.	20	64	50	70.	50	58	40
28.	50	78	52	71.	44	74	48
29.	42	60	70	72.	34	68	50
30.	38	54	48	73.	38	78	44
31.	34	70	54	74.	14	40	42
32.	38	62	58	75.	42	60	52
32.	40	64	38	76.	32	72	38
33.	44	56	60	77.	40	74	78
34.	50	80	70	78.	28	44	40
35.	24	52	48	79.	30	58	42
36.	42	56	60	80.	50	68	64
37.	44	60	62				
38.	52	70	64				
39.	56	60	70				
40.	10	24	40				
41.	34	60	56				
42.	24	62	40				
43.	42	56	64				

GOVERNMENT SECONDARY SCHOOL NAIBAWA**(DEMONSTRATION METHOD)**

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	50	70	62	52.	14	44	40
2.	14	44	40	53.	20	46	38
3.	20	46	38	54.	30	70	60
4.	30	40	20	55.	44	60	50
5.	44	60	30	56.	24	50	60
6.	24	50	10	57.	30	54	38
7.	30	54	38	58.	42	64	44
8.	42	44	34	59.	50	58	40
9.	50	58	40	60.	44	74	48
10.	44	74	48	61.	34	68	50
11.	34	68	50	62.	38	78	44
12.	38	78	44	63.	14	50	42
13.	14	40	42	64.	42	60	52
14.	42	60	52	65	32	72	68
15.	32	72	38	66.	40	74	78
16.	40	74	78	67.	28	54	40
17.	28	44	40	68.	14	44	40
18.	30	58	42	69.	20	46	38
19.	50	68	64	70.	30	40	20
20.	50	70	62				
21	14	44	40				
22	20	46	38				
23.	30	40	20				
24.	44	60	30				
25.	24	50	40				
26.	30	64	68				
27.	42	64	34				
28.	50	88	70				
29.	44	74	48				
30.	34	68	50				
31.	38	78	44				
32.	14	40	42				
32.	42	60	52				
33.	32	72	38				
34.	40	74	78				
35.	28	44	40				
36.	30	58	42				
37.	50	68	64				
38.	50	70	62				
39.	14	44	40				
40.	10	54	40				
41.	34	60	56				
42.	24	62	40				
43.	42	56	64				
44.	22	56	70				
45.	34	64	56				
46.	40	84	60				
47.	44	60	56				
48.	38	58	56				
49.	36	60	58				
50.	42	70	56				
51.	34	58	50				

GOVERNMENT GIRLS SECONDARY SCHOOL YARGAYA (INQUIRY METHOD)

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	42	64	44	51.	34	58	50
2.	50	58	40	52.	48	60	54
3.	44	74	48	53.	34	64	58
4.	34	68	50	54.	44	68	60
5.	38	78	44	55.	36	54	58
6.	14	40	42	56.	42	68	60
7.	42	60	52	57.	40	68	58
8.	32	72	38	58.	34	68	52
9.	40	74	78	59.	36	72	68
10.	28	44	40	60.	36	60	58
11.	30	58	42	61.	42	58	50
12.	50	68	64	62.	50	70	62
13.	50	80	62	63.	14	44	40
14.	14	44	40	64.	20	46	38
15.	10	54	40	65	30	40	40
16.	42	44	34	66.	44	60	30
17.	50	58	40	67.	24	50	60
18.	44	74	48	68.	30	54	38
19.	34	68	50	69.	42	44	54
20.	38	78	44	70.	50	58	40
21	50	68	64	71.	44	74	48
22	36	60	58	72.	34	68	50
23.	42	58	50	73.	38	78	44
24.	50	70	62	74.	14	40	42
25.	14	44	40	75.	42	60	52
26.	20	46	38	76.	32	72	38
27.	30	50	40	77.	40	74	78
28.	44	60	30	78.	28	44	40
29.	24	50	40	79.	30	58	42
30.	30	54	38	80.	50	68	64
31.	34	70	64	81.	34	68	50
32.	38	62	58	82.	38	78	44
32.	40	64	68	83.	14	40	42
33.	44	56	60	84.	42	60	52
34.	50	80	70	85.	32	72	38
35.	24	52	48	86.	40	74	78
36.	42	56	60	87.	28	44	40
37.	44	60	62	88.	30	58	42
38.	52	70	64	89.	50	68	64
39.	56	60	70	90	50	70	62
40.	10	54	40				
41.	34	60	56				
42.	24	62	40				
43.	42	56	64				
44.	22	56	70				
45.	34	64	56				
46.	40	64	60				
47.	44	60	56				
48.	38	58	56				
49.	36	60	58				
50.	42	70	56				

GOVERNMENT SECONDARY SCHOOL DAWAKIN KUDU (INQUIRY METHOD)

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	10	24	40	51.	34	58	50
2.	34	60	56	52.	44	94	70
3.	24	62	40	53.	20	46	38
4.	42	56	64	54.	30	80	50
5.	22	56	70	55.	44	60	30
6.	34	64	56	56.	24	50	10
7.	40	64	60	57.	30	54	38
8.	44	60	56	58.	42	44	34
9.	38	58	56	59.	50	58	40
10.	36	60	58	60.	44	74	48
11.	42	70	56				
12.	34	58	50				
13.	48	60	54				
14.	34	64	58				
15.	44	68	60				
16.	40	74	78				
17.	28	44	40				
18.	30	58	42				
19.	50	68	64				
20.	50	70	62				
21	14	44	40				
22	20	86	78				
23.	30	40	20				
24.	44	60	50				
25.	24	50	50				
26.	30	64	38				
27.	42	44	34				
28.	50	58	40				
29.	44	74	48				
30.	34	68	50				
31.	38	78	44				
32.	14	40	42				
32.	42	60	52				
33.	32	72	38				
34.	40	74	78				
35.	28	44	40				
36.	30	58	42				
37.	50	68	64				
38.	50	70	62				
39.	14	44	40				
40.	10	54	40				
41.	34	60	56				
42.	24	62	40				
43.	42	56	64				
44.	22	86	70				
45.	34	64	56				
46.	40	64	60				
47.	44	60	56				
48.	38	58	56				
49.	36	60	58				
50.	42	70	56				

GOVERNMENT GIRLS SECONDARY SCHOOL AUDU MARIRI (LECTURE METHOD)

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	38	38	44	51.	34	38	20
2.	50	48	44	52.	48	40	54
3.	36	40	48	53.	34	44	58
4.	42	58	50	54.	14	28	30
5.	30	40	52	55.	36	54	58
6.	14	34	40	56.	42	58	60
7.	20	26	38	57.	40	50	58
8.	30	40	20	58.	34	48	42
9.	44	20	30	59.	36	42	48
10.	24	30	40	60.	36	60	58
11.	30	54	38	61.	42	58	50
12.	34	30	44	62.	50	40	42
13.	38	22	48	63.	14	44	40
14.	40	24	38	64.	20	46	38
15.	44	56	60	65	30	40	40
16.	50	30	50	66.	44	60	30
17.	24	22	48	67.	24	50	60
18.	42	56	60	68.	30	54	38
19.	24	30	62	69.	42	44	54
20.	52	40	64	70.	50	58	40
21	50	38	64	71.	44	54	48
22	36	30	58	72.	34	68	50
23.	42	28	50	73.	38	58	44
24.	50	50	62	74.	14	40	42
25.	14	44	40	75.	42	60	52
26.	20	46	38	76.	32	42	38
27.	30	40	20	77.	40	44	48
28.	44	60	30	78.	28	44	40
29.	24	50	40	79.	30	58	42
30.	30	54	38	80.	10	28	64
31.	34	40	54	81.	34	48	50
32.	38	32	48	82.	38	48	44
32.	40	24	38	83.	14	40	42
33.	44	56	60	84.	42	60	52
34.	50	50	50	85.	32	42	38
35.	24	52	48	86.	40	54	78
36.	42	46	60	87.	28	44	40
37.	44	40	62	88.	30	38	42
38.	32	40	64	89.	50	60	64
39.	56	30	50	90	20	40	32
40.	10	54	40	91.	34	48	50
41.	34	40	46	92.	38	58	44
42.	24	52	40	93.	14	40	42
43.	42	36	24	94.	42	40	52
44.	22	46	40	95.	32	42	38
45.	34	44	46	96.	40	54	48
46.	40	34	40	97.	28	44	40
47.	24	30	56	98.	30	58	42
48.	38	38	56	99.	30	38	34
49.	36	20	28	100.	20	40	42
50.	22	30	36				

GOVERNMENT SECONDARY SCHOOL SHEKAR BARDE (LECTURE METHOD)

S/N	Pre test	Post test	Post posttest	S/N	Pre test	Post test	Post posttest
1.	32	44	34	51.	34	58	50
2.	30	38	40	52.	48	50	54
3.	24	44	48	53.	34	54	48
4.	34	38	50	54.	44	58	60
5.	38	48	44	55.	36	54	58
6.	14	30	42	56.	42	48	40
7.	12	30	52	57.	40	48	58
8.	32	52	38	58.	34	38	42
9.	10	14	58	59.	36	42	48
10.	28	44	40	60.	36	60	58
11.	30	48	42	61.	42	18	50
12.	50	48	44	62.	20	30	32
13.	10	20	62	63.	14	44	40
14.	14	44	40	64.	20	46	38
15.	10	24	40	65	30	40	40
16.	42	44	34	66.	44	40	30
17.	50	58	40	67.	24	50	60
18.	44	54	48	68.	30	54	38
19.	34	48	50	69.	42	44	54
20.	38	38	44	70.	50	58	40
21	30	48	44	71.	44	54	48
22	36	40	48	72.	34	58	50
23.	42	58	50	73.	38	48	44
24.	30	40	62	74.	14	40	42
25.	14	24	40	75.	42	50	52
26.	20	26	38	76.	32	42	38
27.	30	40	20	77.	40	54	48
28.	44	40	30	78.	28	44	40
29.	24	50	40	79.	30	38	42
30.	30	54	38	80.	50	48	54
31.	34	50	54	81.	34	48	50
32.	38	42	48	82.	38	58	44
32.	10	14	28	83.	14	40	42
33.	44	56	60	84.	42	40	52
34.	30	60	50	85.	32	42	38
35.	24	52	48	86.	40	54	48
36.	42	56	60	87.	28	44	40
37.	34	50	62	88.	30	58	42
38.	12	10	14	89.	30	38	34
39.	56	60	50	90	20	40	42
40.	10	54	40	91.	30	40	62
41.	34	40	56	92.	14	34	40
42.	24	22	40	93.	20	26	38
43.	42	36	64	94.	30	40	20
44.	22	36	50	95.	44	60	30
45.	34	34	56	96.	24	50	40
46.	40	44	50	97.	30	54	38
47.	44	40	56	98.	34	50	54
48.	38	58	56	99.	38	62	58
49.	16	10	18	100.	40	54	48
50.	42	40	56				