PERFORMANCE AMONG BASIC SCIENCESTUDENTS OF VARIED ABILITIES, INZARIA, NIGERIA

BY

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DECLARATION

I,Maryam SHAIBU (M.ED/EDUC/9782/2011-2012)hereby declare that this dissertation titled "Efficacy of Concept-MappingStrategy on Retention and Performance among Basic Science Students with Varied Abilities in Zaria, Kaduna State, Nigeria" has been written by me. It is a record of my own research work and has not been presented in any previous application for a higher degree. All quotations and sources of information are specifically acknowledged by means of references.

_____ _____

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CERTIFICATION

This dissertation titled "Efficacy of Concept-Mapping Strategy on Retention and Performance among Basic Science Students with Varied Abilities in Zaria, Kaduna State, Nigeria" by Maryam SHAIBU with Reg. No; M.ED/EDUC/9782/2011-2012 meets the requirements governing the award of Masters' Degree (M.ED) in Science Education of 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 Mr. and Mrs. Abu Shaibu for their inspiration and encouragement and to all the JSS Students in Nigeria who were unable to exhibit their talents due to inappropriate teaching strategy.

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ABBREVIATIONS

NCE	-	Nigeria Certificate in Education
FRN	-	Federal Republic of Nigeria
FME	-	Federal Ministry of Education
STAN	-	Science Teachers Association of Nigeria
BSPT	-	Basic Science Performance Test
WAEC	-	West Africa Examinations Council
NECO	-	National Examination Council
NISP	-	Nigeria Integrated Science Project
JSS	-	Junior Secondary School
NTI	-	National Teachers' Institute
NERDC	-	National Education and Research Development Council
MDGS	-	Millennium Development Goals
ICT	-	Information Communication Technology

OPERATIONAL DEFINITION OF TERMS

Academic Performance: It is definedas what students are able to gain in knowledge and skills after completion of instruction.

Efficacy: Abilityto produce a desired amount of effect.

Concept Mapping: It is a structure of diagram that shows knowledge within a discipline composed of concept labels, each enclosed in a box or oval, a series of labeled linking lines and general-to-specific organizations.

Retention: The act or power of retaining and later remembering or recalling the information acquired after a learning process.

Varied Abilities: Varied ability level means the characteristic mode of functioning that individual exhibit in intellectual activities such as learning rate, readiness and overall achievement level when confronted with a problem to solve. Consequently there are high, medium and low ability levels.

Basic Science: Basic Science is defined as a grass root subject that introduces children into the field of science.

Upper Basic science JuniorSecondary School. (JSS 1-3)

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ABSTRACT

This study investigated"Efficacy of Concept-Mapping Instructional Strategy on Retention and Performance among Basic Science Students with Varied Abilities in Zaria, Kaduna, Nigeria". A sample of 120 JSS students were randomly selected from the population of 3,729 students. The sample emerged after pretesting 1,327 students who were randomly selected from the six study schools. They were further categorized into high, medium and low ability on the basis of their performance in the pretest. The three experimental groups were taught the concepts of work, energy and power using concept mapping teaching strategy, while the control group were taught same concepts using lecture method. Pretest; post test and postpost test data generated were analyzed to determine whether the two groups are significantly different in their ability. Three null hypotheses were tested using ANOVA statistic at p-value 0.05 and the following major findings were made: Students exposed to concept mapping teaching strategy achieved and retained the basic science conceptssignificantly higher than their counterparts exposed to lecture method. Also the high medium and low ability level (HML) students in the experimental group achieved better than their counterparts in the control group. There was no significant difference in academic performance of male and female students exposed to concept mapping teaching strategy and lecture method. It is concluded that concept mapping teaching strategy employed by teachers in science teaching has direct bearing on students' performance as students of all ability (HML) exposed to concept mapping teaching strategy achieved and retained learned basic science concepts significantly higher than those taught same concepts using conventional lecture method. Both boys and girls benefitted equally on their exposure to concept mapping teaching strategy. In conclusion concept mapping strategy is an effective strategy for teaching basic science concepts in junior secondary schools and its gender friendly. On the basis of these findings, some recommendations were made, one of which is that concept mapping teaching strategy should be employed by teachers to teach Basic Science and Technology in our schools.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

The word science has been viewed by many scholars in the world; as a matter of fact there is no single definition as regards to the word science. However lots of contributions were made as: Shaibu (2008) defines science as a complex human activities that lead to the production of a body of universal statements called laws, theories or hypotheses which serve to explain the observable behavior of the universe or some aspects of the universe. Usman (2008) defined science as method or processes which require observation, problems solving. Science is not dogmatic and has special characteristics that its tenets are universal and capable of production under same conditions anywhere.

Basic Science is defined as a grassroots subject that introduces children into the field of science (Abayomi, 2004). It is moreover viewed by Atanda& Bello (2009) as a course intended to reduce drastically the incidence of drop out from the formal school and ensuring the acquisition of appropriate level of scientific literacy and life skills for a solid educational foundation.At the junior secondary school level Basic Science was introduced for the purpose of giving solid foundation for subsequent science studies at the higher level (Usman, 2000). The National Policy on Education, (FRN, 2013) changed the title from integrated science to Basic Science which was introduced into Nigerian secondary schools in 1972 at the junior secondary school level. The core objectives of the Basic Science programme are difficult to achieve due to so many factors, such as inappropriate teaching strategy (Usman, 2007). Various activity-based teaching strategies have been employed for the purpose of improving theteaching/learning of Basic Science

at the JSS level. These strategies include inquiry method, demonstration, process approach, cooperate learning and laboratory activity method. (Usman, 2007).

In December 2005,the National Council on Education (NCE) directed the Nigerian Educational and Research Development Council (NERDC) to carry out the assignment of reviewing and restructuring the then existing curriculum for primary and junior secondary school to fit into the 9 year Basic Education Programme. This 9 year education programme stipulated that the child should spend 9 years in primary and JSS levels. According to Adeniyi (2007), the 9 years Basic Science curriculum is the product of re-alignment and restructuring of the revised curriculum for primary science and JSS integrated science add cultural dimension to science education.

The change from Integrated Science to Basic Science came in 2007 when the Nigerian Educational Research and Development Council (NERDC) was mandated to develop curricula for at all levels of the education system in Nigeria. In line with government declaration for a 9 – year basic education programme, the (NERDC) was directed by the council on education (NCE) to restructure and re align the existing primary and junior secondary school curricula to meet the targets of the 9 – year basic education in the context of national economic empowerment and development strategy (NEEDS) and the Millennium Development Goals (MDGS). There came Basic Science that was formally called Integrated Science, (NERDC, 2007). The Basic Science curriculum has changed the Nigerian education system from 6 – 3 – 3 – 4 to 9 – 3 – 4. This was intended to give room for students to improve in the formal school and also ensuring the acquisition of the appropriate levels of literacy, numeracy, manipulative, communicative and life – long skills for laying a solid education. Basic Science

curriculum is a revised curricula of the former primary and junior secondary Integrated Science which was spiral in nature and thematic in approach i.e themes cutting across all the sciences. (Atanda&Bello, 2009).

Most Basic Science teachers use lecture method of teaching which lead to poor academic performance and acquisition of requisite skills (Usman, 2000). The lecture method is a talk-chalk method of teaching in which the teacher does most of the talk while student listen and take down notes. Ezeudu and Agwuga (1996) in Obeka, (2009) described lecture method as a teacher centered method that saves time and allow easy coverage of content but dull, less challenging and promote rote learning. It is therefore an approach which does not promote creativity and innovative excellence, thus a need to review other strategies of teaching, with this information, there is need to try out some other methods of teaching such as concept mapping towards improving teaching and learning of students with varied abilities inBasic Science.

According to Jacobs-Lawson and Hershey (2002) concept mapping is a graph structure containing nodes that are interlinked by labeled, directed arcs. Concept mapping can be used as a knowledge representation tool to reflect relationships that exist between concepts that reside within an individual's long term memory. It is regarded as a network structure in order to aid learning and understanding, sections of a given concept mapping can be regarded as hierarchical tree like structure. When a concept mapping is organized in an hierarchical fashion, the more general and more inclusive concept should be at the top of the map, with progressively more specific (and less inclusive concepts) arranged below them (Novak &Gowin 2001).Concept mapping was initially developed by Joseph D.Novak of Cornel University in the early 1980`s.The teaching/learning strategy was

derived from Ausubel (1968) learning theory which places much emphasis on the influence of students' prior knowledge on subsequent meaningful learning. A concept mapping is regularities to object or event designated by a specific label. They are diagrammatic proposition and proposition means two or more concepts labels linked by words which provides information on relationships or describing connections between concepts. A concept mapping can also be an event or a generalized and symbolized form of a learned object. A concept is briefly a compressed form of our experiments and also stepping stone to pass from fact to abstraction. Concept mapping is a technique that opens the way to represent knowledge schematically (Novak, 2006).

According to Adesoji (2008) students are not the same especially when we find out the rate at which facts and principles in science are being assimilated. This means that disparity exist in the ability to perform specific tasks. The problem lies in the identification and grouping of students in accordance with their ability levels. Identification and grouping of students according to their ability level is of paramount importance as several studies within Nigerian environment have shown that learners are qualitatively different in their ability levels as well as in learning problemsIroegbu, (1998).

However according toAdesoji (2008) the achievement of low ability students has been found to be lowest while that of a high ability student was the highest in a study he conducted on student ability level and effectiveness of problem solving strategy and stratified the student into three (3) ability groups namely high, medium and low. This was done by making use of the scores of students in previous chemistry examinations conducted by the schools.

Academic performance is the teaching/learning process which has to do with attainment of set objectives of instruction (Nnaobi, 2007). In science instructions for instance, if a learner accomplishes a task successfully and attains the specified goals for a particular learning experience, he is said to have achieved.

Retention refers to what is learned minus what has been forgotten (Mang&Mankilik, 2001). Thus, if learners must retain the concept they learnt in Basic Science, a strategy or techniques such as concept mapping which require constructing new idea in a child's mind must be used in the teaching process. Bichi (2001) defined retention as the ability to retain and later recall the information or knowledge acquired after learning, it is also the ability of the long time memory to hold information stored in it. Retention therefore, is the ability to retain and consequently remember things experienced or learned by an individual at the later time. It takes place when learning is coded into memory. This appropriate coding of incoming knowledge provides the index that may be consulted without an elaborate search in memory lane. In this study therefore there is need to try out other teaching strategies towards improving teaching and learning of students with varied abilities in Basic Science at JSS level.

Table 1:1 JS 2 JSCE Results in Basic Science in Zaria Zone, Kaduna State

Year	No. Of Students with pass in credit & distinction (C,B&A grades)	% pass	No. of student with failure (F grade)	% fail
2011	1,211	39	1,886	61
2012	1,904	64	1,064	36
2013	1,094	38	1,770	62
2014	1,460	47	1,656	53
2015	1,720	44	2,220	56

Source: Zonal Education Office Zaria Kaduna State. (2015)

1.1.1 Theoretical Framework

The idea of Concept mapping was developed by American science educator, Joseph Novak in 1974 which provides a techniques for representing knowledge in graphical or diagrammatic forms with ideas or concepts enclosed in boxes/circles and linked with lines and phrases (Novak, 2000). A concept map is analogous to a terrain or road map in the sense that concepts are similar to names of places while relationships are like road or streets (Liu&Hinchey, 2001). The Novak concept maps as instructional tools are two dimensional, hierarchical, nodes-link representations which show major concepts and relationships formed in a domain of knowledge. Several studies on their instructional uses and effect on learning outcome have been carried out particularly in chemistry, ecology and biology for example (Adeneye&Adeleye, 2011).

The dominant thinking in science education and developmental psychology was centered on the work of Jean Piaget, particularly his ideas about cognitive operational stages. Piaget had devised some ingenious interviews administered to children, the results of which could be interpreted to support his theory of stages of cognitive operational development. It was widely assumed that children could not profit from instruction in such abstract concepts as the nature of matter and energy before they reached the formal operational stage of thinking at ages 11 or older. First, Ausubel sees the development of new meanings as building on prior relevant concepts and propositions. Second, he sees cognitive structure as organized hierarchically with more general, more inclusive concepts occupying higher levels in the hierarchy and more specific, less inclusive concepts subsumed under the more general concepts. Third, when meaningful learning

occurs, relationships between concepts become more explicit, more precise, and better integrated with other concepts and propositions.

Concept maps, as the term is used, show the specific label (usually a word or two) for one concept in a node or box, with arrow linking word that create a meaningful statement or proposition. Concepts are defined as perceived regularities or patterns in events or objects, or records of events or objects, designated by a label. Concepts are arranged hierarchicallywith the most general, most inclusive concept at the top, and the most specific, least general concepts toward the bottom. Propositionsare statements about some event or object that shows a relationship between two or more concepts. There may also be cross-linksshowing relationships between concepts in two different areas of the concept map. Identifying new cross links may sometimes lead to a creative insight. Concept maps are also based on an explicit cognitive psychology of learning, and constructivist epistemology, While it does take an hour or two for an experienced person to make a concept map from a 20-30 minute interview transcript, the precision and clarity of the learner's cognitive structure represented this way made it relatively easy to follow specific changes in the student's knowledge structures as she/he progressed through the grades. For many years, concept map were drawn by hand. Iterating through revisions of a concept map was cumbersome and time consuming. Group concept mapping sessions could be handled by using post-it notes. The introduction of personal computers enabled the development of software Programs that facilitated the construction of concept maps. It is generally recommend that learners build concept maps in small groups, since the exchange that occurs between learners can often serve to correct faulty ideas and promote meaningful learning. Thus their exchanges tend to be more meaningful to each member

of the group. Cooperative learning also confers an affective advantage to learners over the usual independent, competitive teaching approaches that can be emotionally deleterious.

Over the years new methods are found for creating concept maps and new applications for their use. New technologies have helped increase the number of applications and the power of the tool. It is likely that this evolutionary process will continue in the future. One of the overriding objectives of science teaching is that student learn scientific concepts in a meaningful manner. Ausubel, (1963) ascertain that meaningful learning results when a person consciously and explicitly ties new knowledge to relevant knowledge and preposition they already possess. Concept mapping could be a potent tool in linking new knowledge to already acquired concepts. In this study an attempt is made to determine the efficacy of concept mapping instructional strategy on academic performance and retention amongBasic Science students with varied abilities, with a view to finding ways of improvement in teaching and learning process of Basic Science.

1.2 Statement of the Problem

Life experiences that are acquired through education and science in particular for national development hang on good teaching/learning. Low academic performance and retention are experienced both in WAEC and NECO examinations as stated in National Policy on Education (F.R.N, 2015).The lecture method has not been able to visualize complex concepts or meet up even the National Policy on Education objectives (F.R.N 2015).

The problem of teaching and learning Basic Sciencemost especially at junior secondary School level still persist (Usman 2007). Despite persistence use of child centered approach, the poor performance of students persists in Basic Scienceat the junior secondary school level, as reported by chief examiners. (Educational Resource Centre, Kaduna 2015). It is further compounded by lecture method of instruction adopted by most teachers which lead to poor student retention of Basic Science concepts. Science is the universal vehicle for human development and civilization worldwide. Hence, it must be taught in a way student will perceive and understand it for meaningful application. Basic Scienceas a fundamental science and an activity based subject should be taught using diversified strategy in order to enhance understanding and achievement of the student.

Available literature also shows that 70% of scientific information or principles are passed to students via lecture method by science teachers. The adherence to the use of lecture method in teaching Basic Scienceover the years has been observed to be responsible for poor academic performance (Bichi, 2002). Usman (2002) has the view that the constant use of lecture method lead to poor achievement in Basic Science. This poor achievement of Basic Scienceamong students at all levels within Zaria Educational Zone as reflected in Table 1.1 Showing percentage of passes at credit and distinction grades and failure in F, grades of JS 2 mock examination for the period of five years in Basic Science. The analysis indicates low achievement in four years.

Thus, this poor achievement of students in Basic Scienceis causing concern and poses a problem in subsequent learning of science related courses. However, a call by

scholars for the use of effective teaching strategies has been made in order to make learning more meaningful.

Hence a need to try out other strategies and use on Basic Science concepts as contained in the syllabus towards improving teaching and learning of JSS Basic Science. Therefore Concept Mapping is used in this study to determine the efficacy of theinstructional strategy on retention and performanceamong BasicScience students with varied abilities in Zaria Education Zone.

1.3 Objectives of the Study

This study determined the relative efficacy of concept mapping strategy on retention and performance among upper Basic Science students with varied abilities. Specifically objective of the study are to:

1. Determine effects of concept mapping on academic performance of students with varied abilities in Basic Science using lecture method and concept mapping.
2. Investigate effects of concept mapping on retention of students with varied abilities inBasic Science.
3. Assess effects of gender onacademic performance of Basic Sciencestudents with varied abilities taught with lecture method and those taught with concept mapping.

1.4 Research Questions

The study investigated the following research questions:-

1. What is the difference in the post test mean score of students exposed to concept mapping and their counterpart exposed to lecture method of teaching with :-
   a. high ability ;
   b. medium ability;

c. low ability.

2. What is the difference inpostpost test mean scoresof students exposed to concept mapping and their counterparts exposed to lecture method with:-
   a. high ability;
   b. medium ability;
   c. low ability.
3. What is the difference in posttest mean scores of male and femaleBasic Sciencestudents exposed to concept mapping teaching strategy and lecture method?

1.5 Null Hypotheses

The following null hypotheses were tested at 0.05 level of significance:-

H_{01} There is no significant difference in the post testmean score of students exposed to concept mapping and their counterparts exposed to lecture method with:-
   a. high ability
   b. medium ability
   c. low ability

H_{02} There is no significant difference in the postpost test mean scores of studentexposed to concept mapping and their counterparts exposed to lecture method with
   a. high ability
   b. medium ability
   c. low ability

H_{03} There is no significant difference in the post test mean score of male and femaleBasic Science students with varied abilities exposed to concept mapping strategy and lecture method.

1.7 Significance of the Study

The outcome of research might be useful to:

The teacherswho would hopefully be enlightened on the effectiveness of concept mapping in teaching upper Basic Scienceand the need for applying it to substitute traditional method (lecture method) frequently used by Basic Scienceteachers.

The Students who would gain as concept mapping fosters creativity and corporation between students moreover students' retention of learned concepts is enhanced.

The publishersespecially book publishers would be inspired to make more publications on concept mapping as less text books are available on concept mapping strategy.

The curriculum planners and other educational agencies as to emphasis concept

Mapping that facilitate meaningful learning.

Professional bodies and associations like Science Teachers Association (STAN) in their emphasis of effective teaching strategy during conferences and workshops.

1.7 Scope of the Study

This study determined the efficacy of the hierarchical concept mapping on retention and academic performance of Basic Science students' with varied abilities. The study covers 6 out of 20 public secondary schools in Zaria Educational Zone and it involves only JSS II upperBasic Sciencestudents. The study was delimited to Day co-educational secondary schools only because 90% of schools in the zone are operating as day schools, the justification for using JSSII students in the study was because they are neither introductory who are not settled or familiar with the school, nor final year students who are busy with exams. The concepts to be covered using concept mapping are:-

I. Work

II. Energy

III. Power

Based on the research by Nwosu, Ibe and Ebere (2014), Teachers have difficulties in teaching the above concepts. The instrument used for data collection is Basic Science Performance Test (BSPT).

1.8 Basic Assumptions

The study has the following basic assumptions;

1. The socioeconomic background of the students and curriculum are the same.
2. The variation of locality of the students plays a role on the achievement of students.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The study investigated the efficacy of concept mapping teaching strategy on retention and performance among Basic Science students with varied abilities.

Chapter one outlined the objectives of the study, research questions and their corresponding null hypothesis. This chapter reviewed literature relevant to the study and isorganized under the following sub headings:

- Philosophy and Objectives of Basic Science
- Curriculum of Basic Science
- Basic ScienceTeaching Methods
- Hierarchical Model of Concept Mapping
- Lecture Method of Teaching
- Ability Level of Students and Academic Performance in Basic Science
- Retention of Learned Concepts in Basic Science
- Overview of Similar Studies
- Implications of Literature Reviewed on the Present Study

2.2 Philosophy and Objectives of Basic Science

Olarewaju (1994) reported that the history of teaching science worldwide at primary and junior secondary schools had its genesis in the eighteenth century through the didactic literature. The common goals which were formulated for teaching science at this period were to;

a. Comprehend the great plan of God

b. Teach moral lessons

c. Show God in nature

d. Know God as the creator of the universe and maker of its laws

Gradually science metamorphosed through the group instruction, object teaching, nature study movement to the very recent development. However the launching of artificial satellite named sputnik 1 triggered the Americans and Britain to have a second look at their science programs. This gave birth to integrated science teaching in these nations.

In Nigeria, in 1968 the West African Examination Council (WAEC) contacted STAN for the purpose of improving the then WAEC's syllabus. According to Oyewole (1972) this led to the subject curriculum development committees set up to look into the changing needs of Nigerian pupils and international trends. The first committee worked on separate subjects, biology, chemistry and physics. Later on another committee was set up to work on Integrated Science which resulted in the deliberation documented inSTAN's Curriculum Development Newsletter No.1 that marked the beginning of integrated science teaching in Nigeria. WAEC consists of a list of subject contents and notes on specific areas that the examination will focus on, thus, it is expected to be used as a guide by both the teachers and the examinees in preparing for a specific examination. The curriculum, on the other hand, consists essentially of the subjectcontents intended objectives, relevant activities and evaluative strategies. Such curriculum, according to Offorma (2005), focuses mainly on the effective teaching of the subject rather than on its examination. Therefore, it always serves as a blueprint for the writing of textbooks, work-books, teachers' guides and other instructional materials.

Different personnel, groups and agencies often specialize in the development of different types of curriculum outcomes (Ajibola, 2008). However, all of them use the national policy on education as their guide. This aspect focuses only on the development of integrated science curriculum.

According to the Science Teachers' Association of Nigeria (1970), Nigerian Integrated Science Project should enable students to be able to:

(1) Observe carefully and thoroughly;

(2) Report completely and accurately;

(3) organize information acquired;

(4) Generalize on the basis of acquired Information;

(5) predict as a result of the generalizations;

(6) Design experiments (including controls, where necessary, to check the predictions);

(7) Use models to explain phenomena, where appropriate; and

(8) Continue the process of inquiry when new data do not conform to predictions.

To achieve these objectives, it is suggested that the teaching of Integrated Science should involve the use of Concept Mapping teaching tactics, problem-solving activities and open-ended field or laboratory exercises.

According to Ndu and Somoye (2007) Basic Science is an Integrated Science designed for junior secondary schools in Nigeria. The National Policy of Education (2013) changed the title from Integrated Science to Basic Science. Therefore the study attempt to investigate the efficacy of concept mapping on academic performance and retention amongstBasic Sciencestudent with varied abilities.

Basic Scienceis a core subject in Nigerian junior secondary school curriculum which is made compulsory for all students as part of their general education program as stipulated in the National Policy on Education (F.M.E, 2008). The relevance of Basic Sciencein the twenty first century as an ingredient of sustaining national development is of paramount importance. This is so because one of the objectives of Basic Scienceaccording to National Education and Research Development Council (NERDC, 2007) is enabling learners to apply their scientific and technological knowledge and skills to meet societal needs.Presently, teaching of junior secondary school Basic Scienceaccording to Usman (2007) involves using the conventional lecture method which may not facilitate meaningful learning and tend to make student see Basic Scienceas abstract and very difficult. Furthermore Wakili (2007) as cited in Olorukooba andLawal (2010) observed that in Integrated Science class rooms most teachers do not adopt Concept mapping strategies and techniques capable of stimulating and creating skills. Considering the above observations it could be observed that there is a need to find convenient and effective teaching strategies that could help immensely the Basic Science students at junior secondary schools with a view to enabling them become more active in class room rather than receptive.

Science is viewed by Madder (2003) as a body of empherical, theoretical and practical knowledge about natural world produced by a global community of researchers making use of scientific methods, with emphasis on the observation, experimentation and explanation of the real world phenomena.

It can therefore be seen that science is a body of knowledge of the entire universe that is systematized and acquired through observation and other process skills

(experimentation, classification, data collection, hypothesis, inference, generalization etc.) leading to the emanation of universal statements in a form of theories and laws which support the exploration of environments toward solving human problems. Thus, science as a human enterprise is learnt in school under subjects' curriculum such as physics, chemistry, and biology offered at senior level of secondary education.

However, these scientific facts or concepts are integrated in order to achieve unity in diversity in science education. The integration of science brings to the teaching of science in a way to present specific ideas in a unified whole.

This basic approach leads to the introduction of subject curriculum which is offered at the junior secondary schools called Integrated Science, now known as Basic Science.

The historical background of Basic Science was dated back since 1968 to mid-1970 in the life of Science Teachers Association of Nigeria (STAN) that was characterized by numerous activities in the review of the science curriculum subject committees which were set up to consider both the changing needs of Nigeria pupils and the international trends to propose detailed guidelines for future science teacher. Therefore Integrated Science began with STAN committees working on the separate on the separate disciplines of physic, chemistry and biology then followed by joint working sessions of representatives from the three committees to make an attempt at the integration of those disciplines bringing the results to unified disciplines called Integrated Science. Therefore integrated science existed for over 40 years as a course that stipulated the use of integrating principles in science which should:

- Be relevant to student needs and experiences,
- Stress the fundamental unity of science,

- Lay adequate foundation for subsequent subject specialist,
- Add cultural dimension to science education.

The change from Integrated Science to Basic Science came in 2007 when the Nigerian educational research and development council (NERDC) was mandated to develop curricula for at all levels of the education system in Nigeria. In line with government declaration for a 9 – year basic education program, the (NERDC) was directed by the council on education (NCE) to restructure and re 0- align the existing primary and junior secondary school curricula meet the targets of the 9 – year basic education in the context of national economic empowerment and development strategy (NEEDS) and the Millennium Development Goals (MDGS). There came Basic Science that was formally called Integrated Science, (NERDC, 2007).

According to Atanda and Bello (2009), the Basic Science curriculum has changed the Nigerian education system from 6 – 3 – 3 – 4 to 9 – 3 – 4. This was intended to reduce drastically the incidence of drop out the formal school and also ensuring the acquisition of the appropriate levels of literacy, numeracy, manipulative, communicative and life – long skills for laying a solid education. Basic Science curriculum is a revised curricula of the former primary and junior secondary Integrated Science which was spiral in nature and thematic in approach i.e. themes cutting across all the sciences. STAN (2004) stressed that "you and "your" home is one of the six themes. The contents now include the issues of shaping the development of the nation identified as globalization, Information Communications Technology (ICT) and entrepreneurship. Therefore, four areas of curriculum innovations were in the Basic Science curriculum, they are:

- Environmental Education (EE)

- Drug abuse Education (DAE)
- Population and Family Life Education (POP/FLE)
- Sexually Transmitted Diseases (STD)

Therefore, Basic Science as a subject had its initial pace through curriculum review on sciences by STAN and is offered at junior secondary schools. Its curriculum is aimed at exploring and acquainting the young child with the environment and also widen his power of thinking, reasoning for further scientific study, and provide the trained manpower in applied sciences to the nation. (National Policy on Education, FME, 2014). Thus, the course plays a vital role the preparing young pupils for higher scientific study and appropriate choice of science related careers and professions.

Stanley (2007) is of the view that, the essence beginning a course in science is to begin to teach students what science is and how scientists work and to achieve the following objective.

- Enabling student to gain concept of fundamental unity of science.
- Instill to students the commonality approach to problems of scientific nature,
- Increasing the students understanding of the functions of science in everyday life and world in which they live,
- Enable students to acquire and demonstrate intellectual competence and professional skills necessary for teaching science.
- Produce well informed and scientifically literate students.
- Develop the ability and motivation of students to work and think in an independent manner.

- Enable students to carry out scientific investigations, emphasize co-operation, and development of appropriate science process skills.

Basic Science became one of the core subjects in junior secondary school and also the bedrock for scientific literacy, technological strength and development of a nation. Its teaching and learning process have to be focused with teaching as the pivot becoming well conversant in the appropriate choice of good teaching methods.

However, the methods or strategies employed are those expected to bring about increased in understanding of scientific concepts, principles and facts that will lead to improvement in academic performance. Therefore the study investigated the efficacy of concept mapping on academic performance and retention amongst upper Basic Science students with varied abilities.

2.3 Basic Science Teaching Methods

Science and technology play a key role in the development of a society. Teaching essentially requires the use of instructional strategies that will enhance meaningful learning and acquisition of skills, thus making science teaching very complex as many activities and concepts are involved. Moreover science is an abstract knowledge which cannot be easily understood using a traditional teaching method. It is however recommended that there should be a change in the style of teaching science by adopting methods and techniques that engage the students themselves. That is, a number of methods and techniques have to be varied and mixed in real life situations (Atadoga&Onaolapo, 2008). Therefore an appropriate choices of strategy or technique of teaching Basic Science is to be made, teaching science as a body of facts (often referred to as concept approach), teaching science as a set of attitudes and ways of solving

problems that typical or characteristics of scientists all over the world (often referred to as process approach) or the (skill focus approach or innovative approach).

However, the choice was actually made in favour of the process approach, though constant bearing in mind that an eclectic stand point may be the answer depending on the teaching circumstances. Atadoga and Onaloapo (2008) opined that science teachers should not be dogmatic in their daily choices of methods and techniques of teaching. This implies that Basic Science and other science teachers should be changing and varying their methods as many times as the need arises during the teaching process of their subjects. It can so be pointed out that effective teachers are good human resources that can produce excellent learners or man power for the nation's development. Apart from good human resource, good teachers have also produced good learning resource which have also helped learners to improve on their performances and greatly achieve in their learning endeavors. In an attempt to each learner better and for them to learn well, several learning theories and methods of teaching have been suggested and put into use by researchers and teachers (Okebukola, 2002). It was also asserted that no one method or theory is the best, new innovations and strategies are also suggested (Okebukola, 2002). Moreover, the frequency with which the teacher changes his/her teaching method will depend on the concept, skill or attitude to be developed in the students, which also depend on these factors to be considered:

- The age of the students,
- The topic to be taught,
- the size of the class,
- The available resources at the teachers' disposal,

- The timing of the lesson to be taught.

On meeting objectives of teaching Basic Science at the junior secondary school, AtadogaandOnalapo (2008) itemized several methods to be employed in the classroom to present scientific facts, information, principles, and skills as concepts which include the following:

- Demonstration method,
- Laboratory / experimental/ activity method,
- Discovery or inquiry method,
- Project method,
- Field trips method

Demonstration method of teaching Basic Science refers to making and exhibition or displaying sometime during the learning process of a Basic Science concept to the students (Atadoga, 2008). This method involves the introduction of new skills or ability to learn a better way of doing something usually accompanied with a lot of explanations and showing how something works or operates. It is commonly used in the teaching Basic Science as materials equipment, apparatus and skills which are vital ingredients in the study of science are exposed or introduced to the students. For instance, the demonstration of the action of unripe orange (acid) on blue moist litmus paper, the use of microscope, dissection of toad or rabbit or handing equipment and materials to observe scientific phenomena. Demonstration method of teaching Basic Science involves:

- teacher demonstration
- students demonstration
- guest teacher demonstration,

In spite of these types of demonstration certain experiments involving expensive or complicated apparatus or complex manipulative skills are better handing by the teacher demonstration or sometimes improvisation is employed. Therefore, since the methods is used to shoe parts of an object or about the fact to the understanding of some principles, demonstration can be done by the teacher only while students are observing and after which the teacher will allow them to do. Therefore to use this methods in teaching Basic Science, the following should be taken into account by the teacher:

- The teacher should make sure that the demonstration will succeed.
- It should be used to guide thinking of all pupils into similar mental direction
- The object to be used should be visible to all students.

However, demonstration method makes the students to have a good relative memory and the knowledge gained lasts longs than if they are simply told. Similarly, interests of the students are motivated when the method is properly used. It also economizes materials needed especially when they are in short supply to go round a large number of student and saves times where times is an important factor. This method measures to avoid breakages, accidents and collection of accurate and reliable results be achieved.

Laboratory or experimental methods is an activity carried out by an individual or a group through the exercise and experimental approaches for the purpose of making personal observation of process, products or events. Laboratory exercise are activities carried out in order to provide practice in design, operating and interpreting experiments. Experiments are operations or procedures employed for the purpose of testing a

hypothesis or a proposition (Atadoga&Onaolapo, 2008). Laboratory exercise has been used in teaching of Basic Science as:

A means to verify science principles, law or theory already known as a way of practicing one or more of the scientific skills such as ability to observe, classify, measure etc. this method can be experimental or outdoor laboratory methods. Example of experimental method is where students examine microscope and identify parts of plants or animals cells while the teacher guide them. In out laboratory students can do activity like planting of beans after being guided by their teacher. An activity can be effectively used to teach basic science, but teachers must ensure that the procedure for the investigation should be very simple and clear. It should be based on the student' background and the availability of equipment needed for the work. This method is encouraging for Basic Science teaching as it leads to better rotation of information and develops formidable attitudes toward science and also enables them to become familiar with such mental processes like observing inferring, classifying and ability for critical thinking.

Discovery method of teaching Basic Science is a lesson designed in such a way that student through their own mental processes to discover facts, concepts and principles. The students then predict the result, make observation and relate the investigation to previous work (inferring). On the other hand, inquiry method is a teaching approach whereby students are allowed to formulate the problem, state the purpose, predict the result, identify procedures and perform the investigation. Moreover, whether discovery or inquiry, it involves instructed exploration in which a students through his or her mental processes such as observing, measuring, classifying, analyzing,

synthesizing and evaluating to draw general conclusions from data which are gathered. Discovery / inquiry methods is students – centered and agrees with early psychologists like Bruner (1966) who said that learning involves active processing of information that is organized and reconstructed in a unique way by each individual.

In using this method the teacher should have the previous knowledge of what the child discovers and ensure that the size of the group is small. The method of discovery in teaching Basic Science increase the students intellectual ability and potentially and help in memory processes and the students' ability to organizes and carryout investigation. It builds up confidence, motivation for further exploration and self-development among students

. Project method is similar to laboratory method; it is meant to individualize instruction. This requires a bit of originality giving students free hand to look for problems which are of special interests to the finding solution to these problems. The method provides for the needs of individual students or sometimes small group so that with special abilities may have opportunities to be fulfilled. According to Atadoga&Onaolapo (2008) topics for project vary and may be obtained from many sources to include:

- Observation of /or in the environment
- Reading scientific books, journals
- Discussion among their colleagues
- Classroom integrations on a specific topic
- Discussion in the workshops and science paper

- Science textbooks, field trips, excursion etc. however this method requires great deal of supervision and guidance from the teacher. It is also a student-centered method.

Another method of teaching Basic Science is the field trip that takes places outside the classroom with the purpose of making relevant observation and gathering specific information of what has been taught in the classroom. The method offers students with the opportunity to be actively involved in scientific processes such as observation, data collection, classification making inference, studying relationship, manipulation of objects etc.

Complete picture of concept being taught is gained or actualized using this method by the students. Field trip is believed to be an important part of an effective science instruction if well planned and plays the same role as laboratory experiments and demonstration because first hand experiences are science instruction if well planned and plays the same role as laboratory experiments and demonstration because first hand experiences are gained in the process (Atadoga and Onaolapo, 2008). Thus Basic Science is an activity based course whose teaching – learning process requires or strategies that concretized concept to the learners. It is on this background the research is going to investigate the efficacy of Concept Mapping on Academic performance and Retention among upper Basic Science students with varied abilities.

Conventional Lecture Method of Teaching:

One of the most popular methods of instruction commonly used for science teaching is lecture method (Atadoga 2008). This method is traditionally referred to as didactic approach is defined as teaching techniques in which one person usually the

teacher present a spoken discourse on a particular subject. Lecture method of teaching emphasize “talk and chalk” in the teaching of science subjects. More than 80% of science information and principles are delivered via lecture. According to Kelly (2009) the teacher dose much of the activity in the form of talking on the board while the student listen. One effectiveness of this method is that it required clear and good command of language, good ability to wire and also it.

- Saves the teacher a lot challenges in the class
- It saves time and energy
- It is expensive as only the chalkboard and without and much stress.
- It allows easy handling of large class without much tress

It also allows for easy converge of syllabus but does not promote meaningful learning. It is purely a teacher centered approach where student are not given opportunity to ask question or given feedback to the teacher (Olanrewaju, 1994).

Moreover according to Atadoga (2008) the conventional lecture method of teaching has the following disadvantages:

- The different ability group presents in any given class not taken care of.
- It is stressful for students sitting for a long period of time only listening and writing. It therefore leads to restlessness and disruption of normal class procedures
- It encourages only role learning without necessarily aiding understanding
- However, suggestion have been proposed for improvement when using traditional methods of teaching.

- It should not be verbal presentation of the facts but students should be involved by asking them question
- There should be clear and loud pronunciation
- Teachers should face the students

The researcher is investigating the efficacy of Concept Mapping on Academic performance and Retention amongst upper Basic Science student with varied abilities.

2.4 Concept Mapping:

Concept mapping is one of the effective strategies that have evolved as useful tool in leading students towards meaningful learning as observed by Maujala (2005). Hierarchical Concept mapping is a visual illustration displaying the organization of concepts and outlining the relationship among or between these concepts. It is also a technique used to organize information or thoughts. (Hoffman & Novak 2003), they are two dimensional, hierarchical diagrams that show the structure of knowledge within a discipline composed of concept labels, each enclosed in a box or oval, a series of labeled linking lines and general-to-specific organization. Nodes represent concepts, Lines represent relations between concepts, Labels on the lines described the nature of the relationship and Arrow heads indicates directions of the relationship. This is in line with objectives of teaching Basic Science by NERDC (2007) which stipulates the active involvement of pupils in the teaching learning process which is aimed at solving problems and relating students experience in other subjects. Hierarchical Concept maps are based on propositions, and represent a particular domain of knowledge, it also illustrate patterns and relationships among concepts.

Teaching science in schools such as Basic Science according to Vanides,Yin, Tomita and Ruiz-primo (2005) is both rewarding and demanding which Creates an exciting learning environment with a rich science curriculum that engage all student in challenging enough. similarly monitoring the progress of as many as 150 individual students and knowing that they understand the science concepts that is being taught is over whelming. As students are introduced to new science concepts, they embark on a cognitive process of constructing meaning and making sense by consciously or subconsciously integrating these new ideas with their existing knowledge. Novak and Gowin, (2001) posited that Concept mapping is used by the teacher to communicate complex ideas to the learners as it provides a geographical summary of students misconception and misunderstanding since concepts hierarchically linked with explanatory phrases or words and this provides a 'kind of visual road map' indicating some of pathways that teachers may take to connect the meaning of concepts in propositional manner. Vanides, *et al* (2005) emphasized that students are asked to connect a pair of concepts with a one way arrow, then label the arrow with a word or short phrase that describes the relationship between the two connected terms. These connected terms can be read as a sentence, such as "Water has density.

"These sentence-two terms linked by an arrow and phrase-are called propositions. Although there are many variations in the way you can design concept map activities, open ended activities that allow student to construct their own map structure are the most revealing. For this reasons, mapping activities with very few constraints and no pre-defined, fill in the blank map structure are considered the gold standard for learning more about connections students are making between important concepts. Furthermore

Hierarchical Concept mapping according to Vanides, *et al* (2005) provides a unique graphical view of how student organize, connect, and synthesis information. As a result, it offers benefits to both students and teachers. Hierarchical Concept mapping is designed according to Yin, *et al* (2005) in three steps as follows:

- Select the most important and critical terms related to the concept being taught and see if u can construct proposition which reflect what student is expected to know and express at the end of the unit.
- Determine where in the unit the maps will be embedded that is consider inserting activities on concept mapping at key junctures in the units.

creation of the activities which means the teacher should design the activity that follow the open ended construct-a-map style in which students are provided with key terms.

Types of Concept Maps

There are four major categories of maps which are distinguished by their different format of representing information (Novak 2004). They are presented as follows:

(i) **Spider Concept Maps**: The spider concept maps is organized by placing the central theme or unifying factors in the center of the map, outwardly radiating the sub themes.

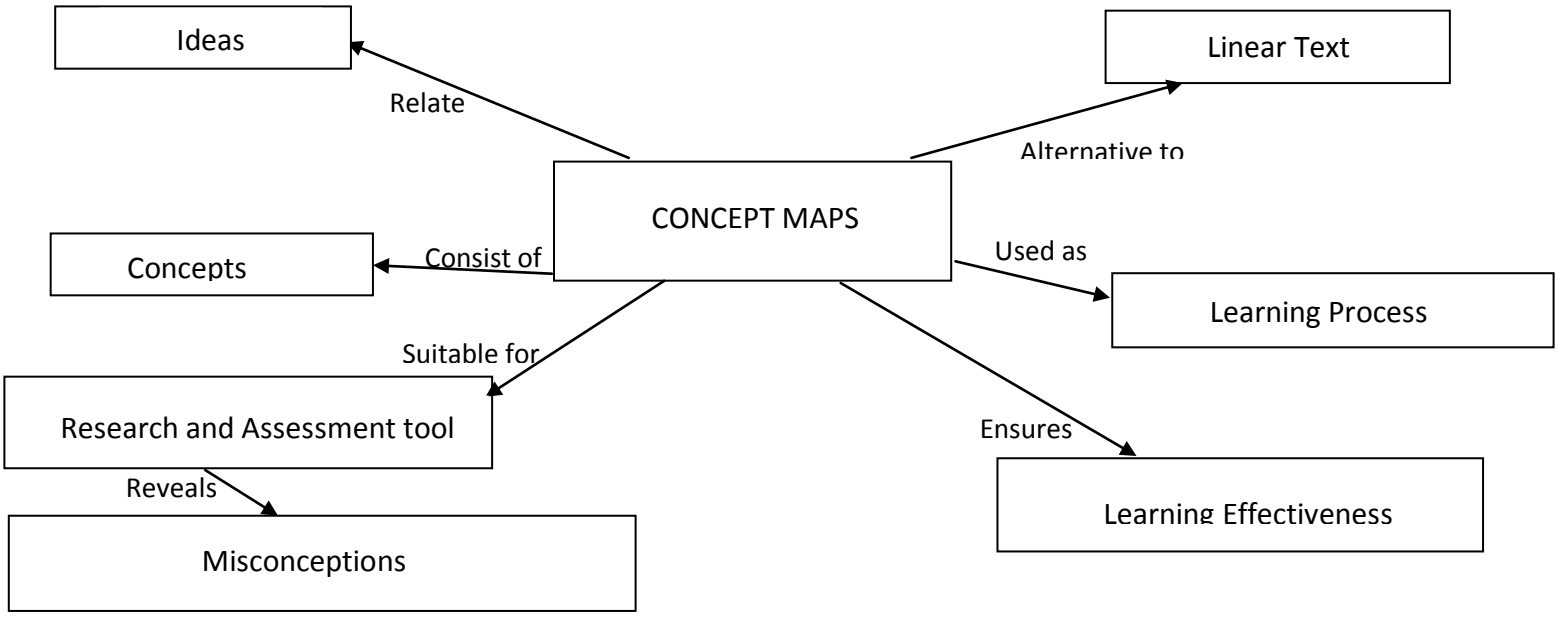
(ii) **Hierarchical Concept Map**: The hierarchy concept map presents information in a descending order of importance. The most important information is placed on top. Distinguishing factors determine the placement of the information. For the purpose of this work hierarchical concept map is used for the study.

(iii) **Flow Chart Concept Map**: The Flow chart concept map organizes information in a linear format.

(iv) **Web Concept Map**: These are non-hierarchical arrangements in which as many interconnecting propositions as possible are shown.

(v) **Skeleton Concept Map**: The skeleton concept map presents information in form of skeleton where there are branches and they descend head first.

Fig. 2.1: Concept mapping



Source: Novak J.D. and Gowin D.B. (1984).

2.5 Lecture Method of Teaching

The lecture in its many form is the most commonly used method of transferring information in education. There are, however serious questions regarding the effectiveness of the traditional lecture approach. Mclntosh (1996) point out that, although the lecture method is used extensively in education, academic staff often are not trained is giving effective lecturers. Ellington (1996) have pointed out that despite the thirty year existence of learning style theories (dealing how people learn); most teachers still dispense information using traditional lecture methods without regard to students learning abilities. These teaching methods are theoretical, extremely didactic and teacher centered instead of being experimental or activity based. A study of teaching behaviour and student's achievement in science by Abdullahi, A (1982), shows that student activities are better than teacher activities in promoting authentic learning, at least in junior secondary school integrated science classrooms.

Lecture as a teaching method is an oral presentation intended to present information or teach people about a particular subject, for example by a university or college teachers. According to Abdullahi (1982), a lecture method, as it is traditionally employed in our schools involves verbal presentation of ideas, concepts generalization and facts. The objectives is to stuff the students with information. Vella (1992) defines the lecture as the format presentation of content by the educator (as subject expert) for the subsequent learning and recall in examination by students. Ruyle (1995) describes the lecture simply as an oral presentation of instructional material. Lectures are generally described from the instructor's point of view, and the student's need for interaction with the instructor is not addressed. In fact, lack of interaction is considered one of the major limitations of the traditional lecture method (Munson, 1992). Mclntosh (1996) observes

that lecturing is frequently a one-way process unaccompanied by discussion, questioning or immediate practice, which makes it a poor teaching method. Most educators learn how to teach based on their experiences as students.

This "teach as I was taught" approach tends to perpetuate the lecture as passive, one-way method of transferring information. The lack of faculty training in presenting effective lecturers, rather than the method itself, may be the greatest weakness of the lecture (Mclntosh, 1996)

The amount of material remembered by students immediately after a lecture as reported by Ellington (1996) is comparatively low, ranging from a maximum of roughly 40% to as little as 5% in some cases. He also reported that a number of studies aimed at comparing lecture method with other teaching/learning methods have been carried out and shown that lecture is not particularly effective in achieving higher cognitive objectives (helping students to apply such basic facts and principles, analyze, synthesize, solve problems, and so on) or in achieving affective and other non-cognitive objectives. Mclntosh (1996), in a related study on the effects of instructional methods and cognitive style on students' academic achievement in junior secondary schools social studies, examined three methods-Advanced Organizer (ADO), Concept Mapping and Activity discussion Method – and found that all three had significant effects when compared to the lecture method. Students taught with the first three methods outperformed those taught with the lecture method.

However, in support of lecture method in Medical Education, Vella (1992) recommends the use of active learning activities including problem-solving exercises, student's presentations and student working cooperatively in groups. According to

Twigg(1994), recent students have shown that the majority of college students and active learners requiring learning experiences that engage their senses.

2.6 Ability Levels and Academic Performance in Basic Science

Many studies such as Adesoji (2008) revealed that learners are not the same as far as learning science concepts is concerned. He stratified students into three groups by making use of their scores in previous examination. The groups are low level group, medium level and high level group. Other studies within Nigerian environment such as Usua (1974) and Ehindero (1980) show that learners are qualitatively different in both their ability levels, cognitive structures and learning problems.

According to Slavin (1987) there are two commonly used type of ability group namely; between class ability groups and within class ability group. Between class ability grouping is a school level practice which is referred to as forming class rooms with a view to making students of similar ability place together.

Within class grouping is a teacher level practice were a teacher group his students that are of similar ability together in a similar class.

Adesoji (2008) shows convincingly that learners assigned to selective schools and classes increase their achievement more than similar student that were enrolled in comprehensive schools of mixed ability classes while student in low level schools and classes fail further and further, though average level of achievement growth were found to be similar in schools by using settings and other schools using mixed ability teaching.

However Adeyemo (2010) observed that teachers, government and general public show great worry about student poor performance and their ability levels on companies to achievement. Also observed was that educational arms of governments and educators

recently show concern on the effect of student motivational stage on how well they score on science related courses. In this research therefore an attempt is made to find the efficacy of concept mapping on academic performance and retention of upper Basic Science students with varied abilities with a view to making improvement in teaching and learning of Basic Science at junior secondary schools level in Nigeria.Adeyemo (2010) emphasized that high ability learners are more intelligent than low or medium ability learners in solving task in science courses. Hence there is need for a fruitful research to be conducted on Basic Science in Nigeria in order to justify which among the three ability group perform better than the other more especially when taught by using concept mapping.

A study conducted by Adeyemo (2010) on student ability level and their competence in problem solving task in physics using a sample of 50 students who were subjected to questionnaire and student achievement test instruments using regression analysis statistics revealed that students ability help significantly in influencing problem solving task. Ability grouping is based on educators' judgment of students' abilities. Bunkure (2012), views that when assigning student to appropriate levels, educators examine prior test scores or other performance, measures that have been provided by educators from other grades or schools. Students are than grouped with others who have been judies to be at a similar level for instructional purposes.

Therefore the teaching – learning process of Basic Science the teacher interacting with children in a class encounters some exiting problems, especially with those who lag behind in the performance and retention of concepts. This may be a result of so many factors which include weakness in attention, perception and memory among others. This

however, brings about the ability of learners to be varied and classified in a classroom setting as low, average and high achievers. This implies that each learner in the class possesses a given level of ability as a factor that can be expressed in various ways, interest, aptitudes, achievement etc. other several elements work together to determine the nature of the ability which an individual has. However ability of an individual learner can be improved upon by a sustained remedial work (national teachers' institute, NTI, 2000). Further, every child is born with different ability to learn and reason. This is however, called intelligence and psychologists have made test for children of various ages, so that reasoning ability can be measured. These tests tell us that intelligence does not change much in life. For instance, if a child is born with poor brain, nothing can done it a very good brain but the child can be taught to make the very best use of the brain. Similarly, a child with a poor reasoning ability may be doing his best, yet his work may not be up to average students of the class.

Also, high ability children may find the work easy, and may not bother to work hard as low ability child in terms of learning scientific facts or concepts and perform better in academic scores and achievement (Mang&Mankilik, 2001). It can therefore, be viewed that students in a classroom vary in terms of their abilities as either low, average or high "the gifted", the "slow learner", the mentally retarded" and "the underachiever". Academic low ability means the performance scores below expected level of attainment as predicted by the students known to measure intellectual ability and actual performance (Adesoji 2008).

It was added by Ezeh (2002), that below learners or low ability are mixed crowd' experiencing various difficulties in learning with their main problem in poor ability to

manage new situation by utilizing former experiences, imagination and required concepts. It is however, important to identify that a child is slow learner or low ability as early as possible so that the child can be given assistance towards improving his learning ability through imparting useful knowledge, reinforcing his characters and develop his personal adequacy and social; competence in order to improve his academic performance. Ogunmade (2006) also observed that a low and poor achievement of students in science with low ability level may be due to the nature of subject, lack of attention by the teachers, lack of elementary preparation. It is therefore, essential for the teachers to device or adopt measure to see that those children are made to fully understand what are learning such as engaging them to constant repetition and revision for them to improve their retention and achievement. Educators have frequently debated the most effective way to meet the needs of gifted learners in the middle grades. Experts in education for gifted (Renzulli& Reis, 1997) have argued for curriculum differentiation and flexible scheduling to allow some ability grouping for young adolescents who are identified as gifted.

Research has addressed the effects of heterogeneous various ability grouping on students with special needs. Students with special needs like other students, need interaction with peer opportunities to develop higher level in thinking recognition of their contributions and equal to quality instructions. According to Lakpini (2007) 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 achievement of students based on their continuous assessment grades or achievement test scores administered in a research work.

The different grades and their corresponding scores according to WAEC (1998) include:

- A1 (75 -100),
- B2 (70 - 74).
- B3 (65 – 69),
- C4 (60 - 64),
- C5 (55 - 59),
- C6 (50 - 54),
- D7 (45 - 49),
- D8 (40 - 44),
- F9 (0 - 39),

The issue of performance of students within a classroom setting in Nigerian secondary schools is faced with lots of factors making students within the same class to perform differently in spite of receiving the same facilities, method of instruction, atmosphere of learning and approach by the same instructor (teacher). One of those factors is difference or variation in the student's ability level. Therefore this study investigated the efficacy of concept mapping strategy on retention and performance amongst upper Basic Science students with varied abilities.

The good use of teaching method and innovative technique has an impact on the academic performance of students in science subjects with Basic Science inclusive. The

decline in the academic performance of students particularly in Basic Science has been of great concern as it has a direct link with students' future and subsequent performance in major subjects and their choice in careers and other science related disciplines.

Students' academic performance refers to the quality of results of students that is reflected in their examination scores. The quality of scores on the part of student academic performance on science is influenced by a number of factors which raise it to fall or improving it to the desired level or standard. In recent times, related literature in science education revealed that students generally performed poorly in all science subjects especially at the secondary school level (Olorrundare, 1993 & Usman, 2007). This poor achievement in science is attributed to poor instructional strategies, lacks of instructional materials, non-use of materials or lack of knowledge skills required to put such resources into productive use (Uyoata, Oladele&Lasis, 2006 &Ogunleye 2008). Nwagbo (1999) added that the consistent poor achievement in science subjects with Basic Science inclusive attests to the fact that science teaching has not been properly done and that is why concepts being taught are not properly understood. This however, reveal that there are quite a great number of factors that have a great influence on teaching and learning process of science that consequently affect students' performance.

Mukhajee (1978) viewed that certainty factors have been found to affect performance of students in their learning subjects including basic science. He summarized those factors as follows: antecedents' developmental factors and training factors. By antecedent factors he explains as those factor as the backing factors which occurred in the child's experience that may affect his learning and understanding of concepts while developmental factor refers to the age to the learners that has a significant

role on the type of concept he can capture and retain. But training factor refers to the amount of teaching instruction and strategy a child was exposed to.

Moemeke and Owoifo, (2003) have made a call for a drastic revolution of the attitude of science and method of teaching science in order to check a problem of poor achievement of students in science. They however, added that teachers should employ those instructional strategies which are activity – based that will enhance students' understanding and retention of concepts. Similarly, Akimade (1992) pointed that failure to use appropriate teaching method/technique in teaching learning process will lead to the decline in student's attitude and performance in science. Thus, the use of appropriate teaching method will take care of differences that affect our learners psychologically, sociologically, emotionally and mentally.

Odunbunmi (1996) pointed out factors such as lack of facilities, shortage of qualified teachers and inappropriate choices of teaching technique which are responsible for achievement of Basic Science students. Additional, effective learning retention of concept and improvement in academic performance of students in science as well as Basic Science can be achieved when more senses are involved; that is seeing, touching and hearing. In recent times, innovations which involve both sense of hearing, touching and seeing have been developed to make learning meaningful.

2.7 Retention Ability in Basic Science

The term retention according to Hornby (2000) is the ability to remember experiences and things learn in the past and also the preservation of mind which implies that the amount of knowledge learnt and kept, maintenance of skill or problem solving behaviors manifested consistently reflect what is retained, this implies that retention of

statistical knowledge is the ability of a student to keep and remember and also recall or reproduce the acquired knowledge or some part of it after some period of time must have passed. While Obeka (2009) refers Retention as the term used to denote the demonstration that learning has been maintained overtime.

In teaching basic science, teacher should ensure good retention attitudes among his student as researches such as Kurumeh, Onahand Mohammed (2012|) revealed that students taught science subjects like mathematics with ethno mathematics approach showed a significant higher mean retention score (60.92) in statistics than their counterpart taught with lecture method who show (39.66) mean retention score. Also revealed by the research is that there was no significant difference in the retention rate of both male and female students taught statistics using ethno mathematics approach which means that both male and female in the ethno mathematics group retained statistic knowledge equally well and with improved retention which affirms that retention in statistics in his study depends on approach of instruction. Mari (2002) posited that teaching strategy is a variable that can easily be manipulated by the teachers in order to increase student retention rate, performance and reduce or eliminate sex related differences in science performance, he also attributed the low performance and retention rate in science especially mathematics of students particularly among sexes to instructional modality adopted by instructors in their research they finally recommended blended instructional techniques towards enhancement of better retention and achievement.

The concept of retention sometimes brings up the idea of memorization and rote learning. It refers to what is learned minus what has been forgotten (Mang&Mankilik,

2001). The theories of forgetting make it clear that forgotten takes places as a result of passage of time. This however has the implication of making Basic Science and other sciences teachers to be in the position of urging and encouraging learners especially the low and average ability groups to engage in contains of what have seen taught. Therefore students of the ability level should strengthen retention ability of the learned facts through memorization, practice and activity based learning. Ochonogor (1997) observed that, an in-depth retention and achievement in science, technology and mathematics is an important need that is becoming highly felt by the Nigerian populace moreover, Adeyemi (2003) and that the way children learn and perceive are reflected in retention scores but that which is imperfectly registered cannot be perfectly retained. Hence to achieve meaningful retention of science concepts, the approach of presentation and technique of teaching should be taken into consideration.Several factors are known to influence retention. Bichi (2002), reports that anything that aids learning should improve retention while things lead that to confusion or interference among learned materials decrease the speed and efficacy of learning and accelerate forgetting.

In recent years, studies on retention and performance have attracted attention of many researchers. Ezenwa (1993) compared the effectiveness of concept mapping and guided discovery teaching strategies on student retention of some chemistry concepts and found a significant difference between the concepts mapping in its favor and guided discovery. Integrated Science which is now changed to Basic Science in the National Policy on Education (FME, 2013) according to Olarewaju (1994) is the amalgamation of biology, chemistry and physics.

2.8 Overview of Similar Studies

Studies related to this research were conducted in different parts of the country as well as in other countries. Keraro,Wachanga&Orara (2007) investigated effectsof concept mapping teaching method on secondary school students' motivation in biology. A non-equivalent control group design under the quasi experimental research was used in which a random sample of four co-education secondary schools was used. The four schools were randomly assigned to four groups. Each school provided one JSII class. The study sample comprised of 156-second grade students in all the secondary schools cycle in Gucha District, Kenya. Students' in all groups were taught the same biology content but two groups, the experimental groups were taught using the concept mapping approach while the other two, the control groups were taught using regular or conventional teaching methods. Both the experimental and the control groups were pre-tested prior to the implementation of concept mapping. After four weeks, all four groups were post-tested using the students' motivation questionnaire (SMQ). Data were analyzed using t-test, ANOVA and ANCOVA. The result shows that students exposed to the concept mapping approach had significantly higher motivation than those taught with normal method. The result further indicated that there was no statistically significant gender difference in motivation towards the learning of biology among secondary school students exposed to concept mapping. The researcher concludes that concept mapping is an effective teaching approach which science teachers need to incorporate in their teaching.

A similar study carried out by Chiou (2008) on advanced accounting course in Taiwan on The effect of concept mapping on students' learning achievement and interest using a sample of 124 students randomly selected and grouped into experimental and control of 62 students each. He used two achievement test on accounting and 10 items questionnaire in form of four Likert scale ranging from 'strongly disagree' to 'strongly agree' as three instrument used in the study applying t-test ,ANCOVA and simple percentage statistical tool. The research revealed that:

- Adopting a concept mapping strategy significantly improved students learning achievement compared to using traditional expository teaching method.
- Most of the students were satisfied with using concept mapping in an advanced accounting course. They indicated that concept mapping can help them to understand, integrate and clarify accounting concepts and also enhances their interest in learning the subject; they also thought that concept mapping could be usefully used in other curriculum areas.

This research investigated the effect of concept mapping on retention and performanceamong upper Basic Science students with varied abilities with a view to filling the gap of Chiou (2008) study that did not take into consideration the retention and varied ability grouping of students. Meanwhile the research is carried out on Basic Science as no research on concept mapping with regards to student ability levels and retention was carried in Nigeria in the subject area.

Similarly a study conducted by De Simone, Schmid and McEwen (2001) on supporting the learning process with collaborative concept mapping using computer-based communication tools and processes ,the study combined three tools that potentially

support and foster students development in the following areas which are: application, investigation ,relational thinking and communication of ideas. The researchers used a sample of 26 students in two intact classes in learning theories using students' background questionnaire tapping into demographics in form of Likert scale and focus group discussion as the instrument. The finding of this research reveals that: the groups' maps differed significantly in the structure of their representation, replicating the findings of De Simone and Schmid (1998). Also revealed by the research is that some students had more traditional appearances of hierarchical maps while others included more cyclical patterns. Also groups varied in their ability to represent the test based knowledge accurately though overall they were successful at analyzing relevant content. However some short comings were encountered by the students as they had a difficult time using the map to support their integrity statements. In other words they fail to create an "argument" which elaborated often the statement such that they could represent evidence for or against it. Also found out was that group-based electronic concept mapping proved to be an effective strategy for identifying and organizing course content. With regards to student interest it was found that students liked concept mapping strategy as it helps them effectively understand the course content, organize it, revised it and complete assigned task. They are also likely to use concept mapping in the future. In this research an attempt is made to investigate the efficacy of concept mapping on academic performance retention and interest on upper Basic Science student with varied abilities in order to make an improvement upon De Simone, Schmid and McEwen (2001) by using a quasi-experimental design with a view to determine the interest and retention of students with varied ability level.

Another study conducted by Jacob, (2014) effect of concept mapping and project based instructional strategy on junior secondary school student performance and attitude towards Geometry in Adamawa Nigeria. The study used geometry achievement test and student geometry attitude questionnaire to support and foster student development in Geometry. The researcher used a sampled of 38 student. The finding of this research reveals that there is significant difference that exists among the group of student when exposed to concept mapping. Therefore it is recommended that concept mapping should be an alternative to lecture method particularly in teaching difficult/abstract geometry concept among the junior secondary students (JSS).

A similarly studies by Ali, A. (2015) on effect of concept mapping and inquiry strategies on achievement and creativity among College of Education Physics students. The research has a sampled of two out of seven colleagues using physics achievement test (PAT) and Ibadan creativity assessment scale in North East Nigeria. The finding of this research reveals that there was no significant difference between both groups in their academic performance after treatment. So it is recommended that concept mapping and inquiry strategies of teaching enhance student's creativity traits and teachers should be trained in the use of learners-centered instructional strategy such as concept mapping.

2.9 Implications of Literature Reviewed on the Present Study

Various studies and observation such as Usman (2007) and FRN (2006) indicated the need for having best strategies that could effectively substitute the traditional expository method of teaching frequently adopted by teachers.

There should be: researches that identify the specific demand for concept mapping usage added to lecture method in the teaching and learning process. More

rigorous documentation and evaluation of professional development programs designed to develop teacher knowledge and skills in the use of concept mapping to facilitate the teaching/learning process. Therefore concerted efforts from all stakeholders in the education sector must be made to put all hand on deck to ensure that much researches on concept mapping are made to facilitate the teaching learning process and their implementation are made continuous.

Concept mapping serves as the best alternative strategy to be adopted by teachers especially in Basic Science teaching as viewed by Maujala (2005), Hoffman & Novak (2003) and Novak & Godwin (1984).

However the researches fail to take into recognition the varied ability levels of students (low, medium and high) as categorized by Adesoji (2008). Other factors such as retention and interest of students in relation to using concept mapping in teaching science subjects such as Basic Science were not prioritized in concept mapping researches. Therefore the area covered for this research as well as the selected topics used and the ability level of the students makes it unique and different from others.

In this study therefore the research investigated the efficacy of hierarchical concept mapping on retention and performance among upper Basic Science students with varied abilities.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The study is carried out to determine the efficacy of Concept Mapping instructional strategy on academic performance and retention amongst BasicScience students with varied abilities. In this chapter a research methodology is discussed under the following sub-headings:

- Research Design
- Population of the Study
- Sample and Sampling Procedure
- Instrumentation
- Validation of the Instrument
- Pilot Testing
- Reliability of the Instrument
- Data Collection Procedure
- Procedure for Data Analysis

3.2 Research Design

The research is Quasi-Experimental where the Experimental groups were subjected to pre-test and post test with treatment, while control group was subjected to pre-test and post-test with no treatment.

The design is illustrated in Figure 3.1

i.e.

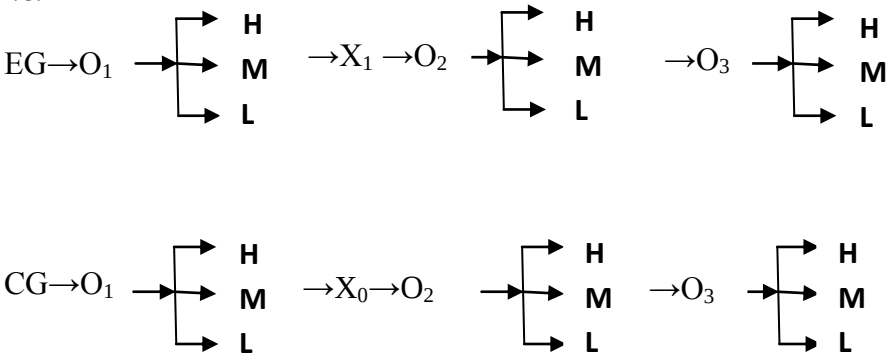


Figure 3.1 Research Design

Where

EG**: -** Experimental Group

CG**: -** Control Group

O_1**: -** Pretest

O_2**: -** Post test

O_3**:-** Postpost test

X_1**:-** Concept Mapping teaching (treatment)

$X_{0:-}$ Control (lecture method)

H**: -** High

M**: -** Medium

L**: -** Low

3.3 Population of the Study

The population of the study comprises 3,729 students in 20 schools with average age of 12-13years, all inJSIIupper Basic science, predominantly Hausa by tribe withHausa cultural background out of which 2,342 are males and 1,387 are females, in Zaria Educational Zone as shown in Table 3.1

Table 3.1: Population of the Study

Schools	No. of JSII students		Total
	Males	Females	
1. GSS Kuyanbana	220	90	310
2. GJSS K/Jatau	163	137	300
3. GJSS Bogari	40	10	50
4. GSS Yakasai	64	35	99
5. GJSS T/Saibu	58	35	93
6. GJSS K/Doka	372	228	600
7. GJSS Aminu	301	96	397
8. GJSS Aba	29	12	41
9. GJSSMuchia	150	100	250
10. GJSS Matari	25	03	28
11. GSS Dinya	33	12	45
12. GJSS Chikaji	125	95	220
13. GJSS Gimba	44	16	60
14. GSSDakache	136	54	190
15. GSS T/Jukun	98	212	310
16. GJSS Awai	50	10	60
17. GJSS Gyellesu	108 42	150	
18. SIASS	174	156	330
19. GJSS Kinkiba	40	08	48
20. GJSS Magajiya	112 39	151	

Source;(Zonal Education Office Zaria, 2015).

3.4 Sample and Sampling Procedure

Six schools had been selected out of twenty schools in the educational zone through simple random sampling techniques using draw-from the hat method. According to William (2005) random sampling is a sampling procedure which assures that each element in a population has equal chance of being selected. This was done by putting the names of all the schools of the population inside a container, squeezed and then picked the six schools. The reason for selecting six schools is because there are three different ability levels (HML) in experimental groups and also three in the control groups.

Therefore there were three schools for experimental and three schools for control groups and a school for each ability level was used during treatment to avoid interference.

Table 3.2 contains six school that were randomly selected. Three of them were randomly assigned as experimental from which a further classification of high, medium and low ability students were considered during treatment after pretest. The remaining three were used as control and equallyclassified as high, medium and low during treatment. The selection was done to arrive at the required number from the school enrolment using draw-from-the-hat-method. The selected students were subjected to pretest and the schools in the experimental and control were further randomly assigned to the different ability levels. Therefore, the sample size used became 120 in which 60 students were subjected to treatment in the experimental and 60 students in the control as indicated in Table 3.2 which gives the details of the selected schools.

Table 3.2: Sample of the Study

S/No.	Name of School	Male	Female	Total	Group
1.	GJSS K/DOKA	3	3	6	Experimental
2.	GJSS Aminu	11	7	18	Experimental
3.	SIASS	20	16	36	Experimental
4.	GJSS K/Jatau	10	3	13	Control
5.	GSS Kuyanbana	12	10	22	Control
6.	GSS T/Jukun	14	11	25	Control
	Total	**60**	**60**	**120**	

3.5 Instrumentation

The instrument used for the study is Basic Science Performance Test (BSPT). It consists of forty multiple choice objective questions developed by the researcher based on the concept of Basic Science taught which were administered during pilot study to

determine the reliability. Same instrument was administered during pretest posttest and post posttest.

3.5.1 Basic Science Performance Test (BSPT)

BSPT was made up of 40 multiple choice objectives questions with four (4) options A-D (three distractor and one correct answer), as shown in Appendix A. This research instrument was administered to the student at the beginning of the first week (test) and collected back for scoring. After an interval of 2weeks the same instrument was re administered to the same students (re test). Test re-test method was used to test the reliability of the instrument, this is in line with the Tuckman, (1975) recommendation and result of the test was analyzed using Pearson Product-Moment Correlation Coefficient statistical tool.

A table of specification was developed based on Bloom's taxonomy for the test items as shown in table 3.3.

Table 3.3: Item Specification Based on Bloom's Taxonomy.

Content	Weight (%)	Know (30%)	Comp (18%)	Applic (22%)	Anal (10%)	Synt (10%)	Eval (10%)	Total (100%)
Work	20	3(11,22,38)	2(30,33)	1(24)	2(1,10)	1(19)	1(5)	**10**
Energy I	20	4(8,9,37,40)	2(6,29)	1(14)	2(21,39)	1(15)	1(13)	**11**
Energy II	30	2(3,27)	2(17,20)	2(34,35)	2(23,31)	1(7)	0	**9**
Power	30	3(2,18,36)	2(26,28)	1(25)	2(4,32)	1(12)	1(12)	**10**
Total (100%)	**100**	**12**	**8**	**5**	**8**	**4**	**3**	**40**

Source: (Adapted from NTI, 2009).

3.5.2 Administration of treatment

The procedure for treatment administered was as follows; the experimental groups were exposed to concept mapping methods, for 2hours a week for 4weeks contact session. The concept maps were illustrated in the experimental group lesson plan as in Appendix C. The experimental group was taught by researcher for the period stated.

The instruction adhered to the following guidelines as in Figure 3.1.

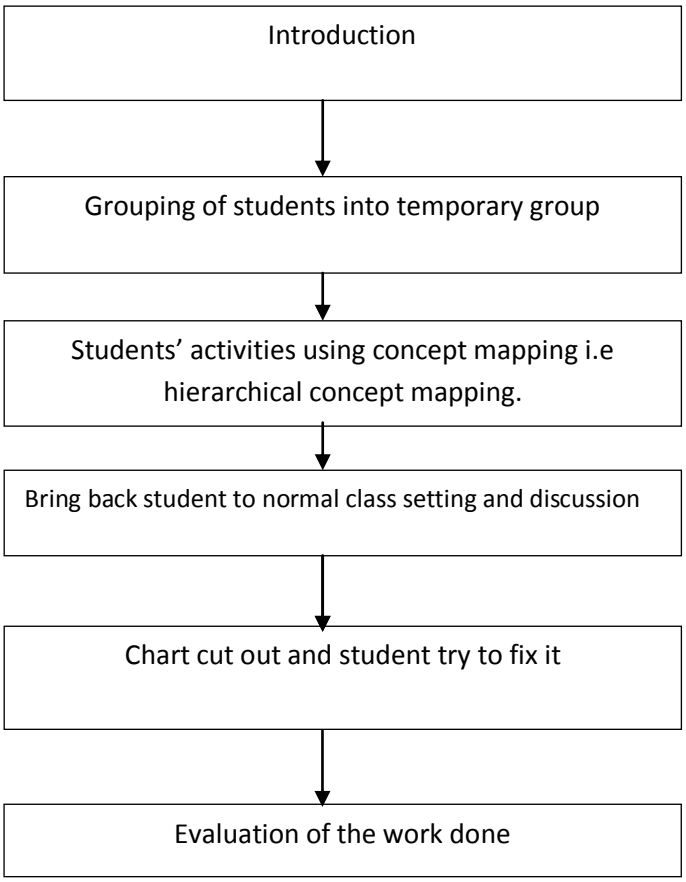


Fig. 3.1: Flowchart to illustrate Hierarchical Concept Map

Adapted from (Novak, 2004)

3.6 Validity of the Instrument

The instruments were validated by three experts with minimum qualification of PhD and minimum Rank of Senior Lecturers from Science Education Department A.B.U Zaria. They were presented with copies of developed items (Basic Science Performance Test, Lesson plan for Experimental and Control group, Marking scheme and Table of specification) for validation. The experts were requested to study the instrument and certify;

i. The conformity of the test items with subject content area.

ii. Ability of the items to actually test basic ideas in work energy and power.

iii. Correct possible errors in the suggested answers.

3.7 Pilot Testing

The Basic Science Performance Test was pilot tested using test re-test method at GJSS Chikaji, Zaria, using 40Basic Science students. They have similar programme with the schools to be used for the main study.

The aim of the pilot testing includes the following, to;

1. Provide further information such as the reliability coefficient of the instruments for the research;
2. Find out and effect corrections where applicable before the main study.
3. Access the validity of the items;
4. Determine the appropriate time duration needed to carry out the main study and for the subjects to write the tests;
5. Establish the difficulty and discrimination level of the items.

3.8 Item Analysis of BSPT Items

Item analysis is a process of examining the performance on individual test items. In this study, item analysis was carried out on all the achievement test to determine the difficulty index (P) and discrimination index (D) for the purpose of standardization.

3.8.1 Difficulty Index

The difficulty index of an item in a test as defined by Iyang (1988) is the percentage of all students who responded correctly to the item. Item difficulty index can vary from 0.00 to 1.00, and 1.00 indicates that everyone answered correctly, while 0.00 means no one answered correctly. In computing the difficulty index for each item in the test, the following steps are involved:

- Rank – order of the scores on the test from highest to lowest.
- Identification of the high scoring group and the low scoring group. The top scoring one third of the students and the bottom scoring one third.
- Determine the percentage of high scores and low scores passing an item.
- Computation of the item difficulty index by adding the percentage of those correct in the high scoring and low scoring and then divide by:

The formula is P= $\frac{U+L}{N}$ (NTI, 2006)

Where P = item difficulty

U = number of student that got the item right in the upper one third.

L = number of student that got the item right in the lower one third.

U = number of students involved in the analysis.

Difficulty index of 75% or higher is regarded as easy in terms of difficulty level. Where the index is 25% or less, the item is hard in terms of difficulty level. In the Basic Science Performance Test (BSPT) the difficulty index that falls between the ranges of 25% to 70% were retained. The details of the result is presented in appendix F.

3.8.2 Discrimination Index

The discrimination index of a test is the measure of the validity of an item. It is a measure of an item's ability to discriminate between those who scored high on the total test and those who scored low. According to Mahmud (1999) the discrimination index of a test item is its ability to separate and rank any student in a test. Items showing little or no difficulty or item that show a percentage of success in favour of the poor group should either be eliminated or re-examined and such items should be re-worded.

Discrimination index can vary from -1.00 to +1.00. A negative discrimination index (between -1.00 and zero) results when more students in the low group answered correctly than students in the high group. A discrimination index of zero means equal numbers of high and low students who answered correctly, so the item did not discriminate between groups. A positive discrimination index occurs when more students in high group answer correctly than the low group.

The discrimination index of the Basic Science Performance Test (BSPT) was calculated using the formula given by Iyang (1988) and James (200).

Thus: $D = \frac{RU - RL}{N}$

Where D = discrimination index

RU = number of students who scored the item correct in the upper group;

RL = number of students who scored the item correct in the lower group;

N = number of respondents in each of the upper and lower groups.

According to Iyang (1988) and James (2000) items with discriminating index which ranged from 0.30 to 0.4 are moderately positive and those above 0.49 are highly positive. The discrimination indices for all the item used for the Basic Science Performance Test (BSPT) fall within 0.29to 0.71. Therefore, the discrimination indices are highly positive which implies that the (BSPT) is now suitable for what it is meant fori.e testing the Basic Science Performance Test. The discrimination index for the items in the achievement test are presented in appendix E.

3.9 Reliability of the Instrument

The reliability of BSPT was determined using test re-test method and Pearson Product-Moment Correlation (PPMC) Statistics. From the result obtained the reliability of the instrument was found to be r = 0.71. These revealed that there is strong and positivecorrelation between the first and second BSPT administered to the students. Therefore the instrument is said to be consistent and reliable for the study. This is supported by Bichi, (2002) who stated that a test is said to be reliable if repeated measurements using the test gives more or less the same result.

3.10 Data Collection Procedure

The Basic Science Performance Test was administered to all the groups as a pretest before the treatment. The test lasted for an hour and the student answer all the questions. This is to measure the knowledge of Basic Science and the equivalent ability

of both experimental and control groups before treatment. There was treatment after the pretest with the experiment groups. The treatment lasted for four weeks. The post and the post test is to find out the effects if any of the treatments on the experimental group. The same test was used as a post test and post posttest though the questions were reshuffled after each application to avoid the students cramming the questions.

3.11 Data Analysis

The data collected wereanalyzed using the following statistics:

H_{01} There is no significant difference in the post test mean score of students exposed to concept mapping and their counterpart exposed to lecture method with varied abilities.

This hypothesis was tested using ANOVA at $P < 0.05$ level of significance.

H_{02} There is no significant difference in the postpost test mean scores of student exposed to concept mapping and their counterparts exposed to lecture method withvaried abilities.

This hypothesis was tested using ANOVA at $P< 0.05$ level of significance.

H_{03} There is no significant difference in the post test mean score of male and femaleBasic Science students exposed to concept mapping strategy and lecture method.

This hypotheses wastested using ANOVA at $P< 0.05$ level of significance.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The study investigated the Efficacy of Concept-Mapping Instructional Strategy on Retention and Performance among Basic Science Students with Varied Abilities. Chapter three discussed research design, population of the study, sample and sampling procedure, instrumentation, validation of instrument, pilot study, reliability of the instrument, data collection procedure and procedure for data analysis. This chapter is discussed under the following subheadings:

- Data Analysis
- Answering the Research Questions
- Testing the Null Hypotheses
- Summary of Findings
- Discussion of Results

4.2 Data Analysis

The result of the study is presented according to the research questions and hypotheses stated in Chapter One. The data were collected using a validated instrument titled Basic Science Performance Test (BSPT). Three types of data were generated using the instrument BSPT which includes; Pre-test data to establish group equivalence, post test data to establish achievement and postpost test data to investigate retention. Two

groups of students were involved in the study. The analysis essentially involved statistical testing of the hypotheses stated in Chapter One.

4.3 Answering Research Questions

Research Question One: What is the difference in the post test score of student exposed to concept mapping and their counterparts exposed to lecture method with:-

a. high ability;

b. medium ability and

c. Low ability?

Descriptive statistics in form of mean and standard deviation were used to answer this questions. The means and standard deviations of posttest scores of experimental and control groups were calculated and shown in Table 4.1

Table 4.1: Means and Standard Deviations Post Test Scores of Experimental and Control Groups

Groups	Abilities	N	Mean	SD	Mean diff
Experimental	High	6	40.67	3.67	
	Medium	18	33.33	3.19	7.34
	Low	36	23.42	6.29	9.91
Control	High	13	33.38	3.64	
	Medium	22	26.68	2.00	6.70
	Low	25	15.44	4.86	11.24

Table 4.1 reveals that students in the experimental group has a means of 40.67, 33.33 and 23.42 and standard deviations of 3.67, 3.19 and 6.29 for high, medium and low ability levels respectively. Which is greater than the means of control group 33.38, 26.68 and 15.44 with standard deviation of 3.64, 2.00 and 4.86 for high, medium and low ability levels respectively. This means that students taught Basic Science concepts using

concept mapping achieved higher academically than their counterparts at all levels, exposed to lecture method.

Research Question Two: What is the difference in post posttest mean score of students exposed to concept mapping and their counterparts exposed to lecture method with:-

a. high ability;

b. medium ability and

c. low ability?

To answer this question, means and standard deviations of postpost test scores of the experimental and control groups were calculated and presented in Table 4.2

Table 4.2: Means and Standard Deviations of PostpostTest Scores of Students in Experimental and Control Groups

Groups	Abilities	N	mean	Standard deviationm.df Mean Rank
Experimental	high	6	46.50	5.85 02.5
	Medium	18	43.11	3.23
	Low	36	33.22	5.94 6.48
Control	high	13	43.00	3.53
	Medium	22	36.63	2.70 8.82
	low	25	24.40	5.29

From the Table, the mean statistics shows that post-post test mean scores of experimental group were 46.50, 43.11 and 33.22 by high, medium and low ability levels respectively, while the control group were 43.00, 43.11 and 24.40 by high, medium and low ability levels respectively. This means the experimental group retained the learnt concept higher than the control group

Research Question Three: What is the difference in post test mean scores ofmale and female Basic science students exposed to concept mapping teaching strategy and lecture method?

To answer this question the means and standard deviations of posttest scores of male and female students in experimental group and control group were calculated and presented in Table 4.3

Table 4.3: Means and Standard Deviations of Post Test Scores of Male and Female Students in Experimental Group and Control Group

Group	Gender	N	Mean	Std. Deviation	Mean Difference
Concept map	Male	36	26.61	7.886	
				3.77	
	Female	24	30.38	8.010	
Lecture	Male	34	25.21	7.954	
				4.06	
	Female	26	21.15	7.983	

Table 4.3 indicates that the mean score of male students in experimental group was 26.61 with standard deviation of 7.886. Female students in the same group have a mean score of 30.38 with standard deviation of 8.010. These means there was no significant difference between the two means, thus gender does not have much impact on achievement when students are taught using concept mapping strategy.

4.4 Testing Null Hypotheses

The following null hypotheses were tested at 0.05 levels of significance

Ho_1: There is no significant difference in the post test mean score of students with varied abilities taught using concept mapping and those taught with lecture method.

The posttest scores of the students in experimental and control groups were subjected to ANOVA. Summary of the analysis is presented in Table 4.6.

Table 4.4: Two Way Analysis of Variance of Post Test Scores of Students in Experimental and Control Groups

Source of Variation	SS	DfMS	F	Sig	R
Corrected model	6000.274	51200.05555.112	.0011S		
Intercept	72512.176	1	72512.176	3390.5	.0011 S
Ability	5160.855	2	2580.427	120.65	.0011S
Group	1164.123	1	1164.123	54.432	.0011 S
Ability*Group	10.493	2	5.248	24.5	.007 S
Error	2438.093	114 21.387			
Total 88212.000		120			
Corrected Total	8438.367	119			

Significant at P≤0.05

Table 4.4 shows that significant difference existed in the mean academic achievement for the two groups with 0.0011 less than the P value of 0.05, Thus, null hypothesis that states, there is no significant difference between the academic performance mean scores of students with varied abilities taught using concept mapping strategy and those taught the same concepts using Lecture Method is hereby rejected. The significant difference was in favour of students exposed to concept mapping strategy as revealed in their mean scores.

Table 4.5:Scheffe's Test of Mean Performance of Experimental And Control Groupsbased on their Ability Levels

(I) Ability Groups	(J) Ability Groups	Mndff(I-J)	Std. Error	Sig.R	
Experimental Group					
High	Medium	7.333*	2.518	.019S	
	Low	17.250*	2.355	.001	S
Medium	high	-7.333*	2.518	.019	S
	Low	9.917*	1.542	.61NS	
Low	high	-17.250*	2.355	.001	S
	Medium	-9.917*	1.542	.61NS	
Control Group					
high	Medium	6.703*	1.320	.001	S
	Low	17.945*	1.291	.001	S
Medium	high	-6.703*	1.320	.001	S
	Low	11.242*	1.103	.001	S
Low	high	-17.945*	1.291	.001	S
	Medium	-11.242*	1.103	.001	S

The Post Hoc analysis using the Scheffe'stest shows that in the experimental group, the low and medium ability level shows no significant difference in their performance, because their significant value recorded is 0.61 which is greater than p value 0.05 meaning that low achievers gained and the performance is not different from those in the medium ability exposed to concept mapping while the control group all the ability level shows significant difference.. The null hypothesis which states that there is no significant difference in the mean performance among the experimental group of students on the basis of their varied ability is hereby retained.

Ho_2: There is no significant difference in the post posttest mean score of students with varied abilities taught with concept mapping and lecture method of teaching.

The students in the experimental and students in the control groups were used for this analysis. The hypothesis was tested using ANOVA followed by the scheffe's test. Result is summarized in Table 4.5

Table 4.6: Retention Ability of Students in the Experimental and Control Groups of Different Ability Levels.

Source of Variation	SS	DfMS	F	Sig	R
Corrected model	5785.776	51157.15	551.477	.0011S	
Intercept	124812.445	1 124812.445	5552.5	.0011 S	
Ability	4760.843	2 2380.421	105.89	.0011S	
Group	856.802	1 856.802	38.116	.0011S	
Ability*Group	100.150	2 50.075	29.28	.002S	
Error	2562.591	11422.479			
Total 157174.000		120			
Corrected Total	8348.367	119			

Significant at P≤0.05

In Table 4.6 the result of analysis shows that significant value recorded is 0.002 which is less than p value of 0.05. It means there is significant difference in the retention of all the ability level in both experimental and control group. Therefore, the null hypothesis that states that there is no significant difference in the retention ability of student with varied abilities taught using concepts mapping and those taught using Lecture Method is thus rejected

Table 4.7:Multiple Comparisons ofMean Retention of Experimental and Control Group
Scheffe

(I) Ability Groups	(J) Ability Groups	Mean Difference (I-J)	Std. Error	Sig.	R
Experimental Group					
High	Medium	3.38889	2.48622	.401	NS
	Low	13.27778*	2.32565	.001	S
Medium	high	-3.38889	2.48622	.401	NS
	Low	9.88889*	1.52249	.001	S
Low	high	-13.27778*	2.32565	.001	S
	Medium	-9.88889*	1.52249	.001	S
Control Group					
high	Medium	6.36364*	1.44838	.001	S
	Low	18.60000*	1.41573	.001	S
Medium	high	-6.36364*	1.44838	.001	S
	Low	12.23636*	1.21031	.001	S
Low	high	-18.60000*	1.41573	.001	S
	Medium	-12.23636*	1.21031	.001	S

Table 4.7 shows Post Hoc analysis using the scheffe's test which indicates that in the experimental group high and medium ability level shows no significant difference because the significant value recorded is 0.40 which is greater than p=0.05 but high and low ability level shows significant difference, the null hypothesis which says that there is no significant difference is retained. While in the control group all ability levels shows significant difference because their significant value recorded is 0.001 which is less than p=0.05. Therefore the null hypotheses which state that there is no significant difference in the mean retention among the experimental groups on the basis of their varied ability is hereby rejected.

Ho_3: There is no significant difference in the post test mean score of male and female students taught Basic Science using lecture method & concept mapping strategy.

This null hypothesis was used to determine whether academic performance scores of male and female students would differ when concept mapping Strategy is used. ANOVA was used to test this hypothesis.

Table 4.8: Analysis of Post Test Scores of Male and Female Students in Experimental Group

Source of Variation	SS	Df	MS	F	Sig	R
Corrected model	1099.243	3	366.414	5.791	.0011	S
Intercept	77778.457	1	77778.457	1229.34	.0011	S
Group	822.326	1	822.326	12.997	.0011	S
Gender	.605	1	.605	.010	0.11NS	
Group*Gender	444.871	1	444.87	1.031	0.12NS	
Error	7339.124	116	63.268			
Total	88212.000	120				
Corrected Total	8438.367	119				

Result in Table 4.8, indicates that for gender and ability level of experimental group shows no significant difference, the significant value recorded is 0.12 which is greater than p = 0.05 therefore the null hypothesis which states that there is no significant difference between the academic performance of male and female students taught using concept mapping is retained. Therefore the result indicate that the concept mapping strategy employed in this study is gender friendly.

4.5 Summary of Findings

In this study, the following findings are made:

- There was significant difference between the post test mean scores of experimental and control groups in favour of experimental group. This implies that, students with varied abilities in the experimental group taught energy, work and load concepts using concept mapping strategy achieved significantly higher

than students with varied ability in the control group taught the same concepts using lecture method.

- There was significant difference in the retention levels of the students with varied abilities taught using concept mapping than those taught with lecture method.
- There was no significant difference between the academic performance of male and female students taught using Concept mapping Strategy and those taught with lecture method. Thus, concept mapping strategy is gender friendly.

4.6 Discussion of Results

From the analysis above, there is significant difference between the academic performances of the students in experimental and subjects in the control groups in favour of experimental group. A significant difference implies rejection of the null hypothesis. Thus, null hypothesis that states that there is no significant difference in the academic performances of students taught using concept mapping strategy and those taught the same concepts using lecture method is hereby rejected. The significant difference is in favour of experimental group. The reason for the difference was attributed to the concept mapping strategy which allow students to participate actively in the lesson and get assistant and feedback directly from their peers.

The result of this findings is supported by, Bichi, (2002), Danjuma (2005) and Akor-Ebutu (2006) who showed in their various studies that concept mapping teaching strategy is superior and more effective in improving student performance and retention of learned science concepts. The superiority of the strategy over traditional teaching method

has also been reported by Owolabi (2002) who compared the effectiveness of the strategy with traditional method in teaching physics.

This finding gain further supports from the findings of the work of Chiou (2008), in a study conducted on the effects of a concept mapping strategy on student achievement and interest. His findings revealed that concept mapping teaching strategy makes the learner to construct his own knowledge to be used in later time. The knowledge they acquire through this strategy is retained and recalled faster than those impacted through mere talk and chalk method.

From the findings in Tables 4.2 and 4.5, the study revealed that experimental group recorded the highest retention mean scores of 46.50, 43.11 and 33.22 while mean scores of 43.00, 43.11 and 24.40 were recorded for control group. It was concluded that since the critical p-value of 0.0011 is less than the alpha value of 0.05, there is a significant difference in the retention level in experimental and in the control groups. The significant difference is in favour of the experimental (concept mapping strategy) group as revealed in their mean score. This finding is in agreement with the work of Askin, (2007), Adeneye and Adeleye, (2011), Bichi, (2002) who in his separate studies revealed that understanding and retention are product of meaningful learning when teaching is effective. It is also in agreement with the work of Idris (2014) who worked on impact of problem-solving teaching strategy on academic achievement and retention in selected basic science. The result of his finding confirmed that students that are taught using concept mapping, have higher retention level than the students exposed to conventional teaching method. In the same vein, Usman (2000) and Abdullahi reported that conventional lecture method used by most teachers is inferior in promoting effective

learning. They use it only for easy coverage of syllabus. Concept mapping promotes easy assimilation with a lot of interaction among the students.

From the findings in Tables 4.3 and 4.6, it was revealed that the calculated p-value of 0209 for interaction between gender and treatment group was found to be higher than the 0.05 alpha level of significance. The experimental group has mean of 26.61 and 30.38 for male and female respectively while control group has mean of 25.21 and 21.15 respectively. The finding therefore indicates that there is no significant difference in the academic performance of male and female students exposed to concept mapping teaching method. Thus, the null hypothesis that states there is no significant difference between the academic performance of male and female students taught basic science using concept mapping is hereby accepted and retained. This means concept mapping teaching method is gender friendly.

This report agrees with the earlier reports by Chiou, (2008), Johnson, Adeneye and Adeleye (2011), Askin (2007) and Usman, 2000. Ali, (2015)'s reported that there is no significance difference between male and female achievement in biology and chemistry but reported a significant difference in physics (boys scoring higher). More so, this finding of no significance difference between male and female performance taught basic science using concept mapping is supported by the findings of Bichi, (2002), Lakpini, (2006) and Bunkure, (2012). Therefore, the concept mapping teaching strategy is gender friendly as far as this study is concern.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In the previous chapter, data obtained were presented, analyzed, interpreted and discussed. This chapter outlines the summary of the study, findings, conclusion and recommendations. The Chapter is presented under the following sub-headings:

5.2 Summary

5.3 Conclusion

5.4 Contributions to Knowledge

5.5 Recommendations.

5.6 Limitations of the Study

5.7 Suggestions for Further Study

5.2 Summary

In chapter one, background of the study was presented, the problems that prompted the researcher to conduct the study, theoretical bases upon which the study form its framework and significance of the study were discussed accordingly. The study was guided by three research objectives, three research questions and three research hypotheses. Chapter two focused on the review of the relevant and related literatures which were reviewed under the following sub-headings. Basic Science at a Glance, Philosophy and Objectives of Basic Science, Curriculum of Basic Science, Basic Science Teaching Methods, Concept Mapping Teaching Strategy, Lecture Method of Teaching, Ability Levels of Student and Academic performance in Basic Science, Retention of Learned Concepts in Basic Science, Overview of Similar Studies and Implications of the Literature Reviewed on the Present Study. Chapter three focused on the research

methodology, the research design, the population of the study, sample and sampling technique used. The sample for the study comprised a total of one hundred and twenty students drawn from the three public day co-educational secondary schools in Zaria education zone, Kaduna-Nigeria using a purposive sampling technique. A- 40 items research instrument tagged Basic Science Performance Test (BSPT) with reliability coefficient of 0.71 duly validated by experts was used to collect relevant data which were analyzed using t-test and Pearson Product Moment Correlation Coefficients with the aid of Statistical Package for Social Science Software (SPSS).

In Chapter four the analysis of data collected, the results obtained, the findings and discussion of the result were presented. Table 4.1 is the Comparison of the Posttest Mean Academic Performance of the Students in the Experimental and in Control Groups. Table 4.2 is the comparison of the Mean and standard deviation of retention level of student in Experimental and in the Control Groups. Table 4.3 is the comparison of Mean and Standard Deviation of Posttest Academic Performance of Male and Female student in the Experimental Group and in the control group. Table 4.4 is the comparison of the two way analysis of academic performance of students in Experimental Group and control group. Table 4.5 is retention level of students in Experimental Group and control group. Table 4.6 is the Analysis of Posttest Mean Academic Performance of male and female students in experimental and control group. Chapter five focuses on the summary of the entire research work, summary of the major findings, conclusion, recommendations, and contributions to knowledge, limitations and suggestion for further studies.

5.3 Summary of Major Findings

The following are the summary of the major findings:

1. Significant difference exists between academic performance of students taught basic science using Concept mapping instructional Strategy (Experimental group) and their counterparts who were taught the same concept using lecture method (Control group). Students in experimental group performed significantly better than the students in the control group.
2. Significant difference exists in the retention levels of students taught basic science using Concept mapping Instructional Strategy (Experimental group) and their counterparts who were taught the same concept using lecture method (Control group). The retention levels of students in the experimental group was significantly higher than the students in the control group.
3. There is no significant difference between the academic performance of male and female students taught basic science concept using Concept mapping instructional Strategy. The male and female students performed relatively equal. Thus, Concept mapping teaching Strategy is gender friendly.
4. The academic performance of the different ability levels (high, medium and low) students who were taught basic science concepts using concept mapping instructional strategy (experimental group) is higher than that of the control group taught same concepts using lecture method. The students of the different ability levels, that is high, medium and low (HML) in the experimental group achieved significantly better than those in the control group.

5.4 Conclusions

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

- Concept mapping Instructional Strategy is aneffective strategy for teaching basic science concept in junior secondary school students.
- Concept mapping Instructional Strategy appears to promote retention of basic science concept among junior secondary school students.
- Concept mapping Instructional Strategy appears to be gender friendly as it favored both male and female students in the experimental group.
- Lecture method of teaching science appeared to be inferior compared to concept mapping instructional strategy with respect to students' academic achievements and retention ability.
- Students of high, medium and low ability levels exposed to concept mapping achieved significantly better than those of high, medium and low ability levels exposed to lecture method.

5.5 Contributions to Knowledge

This study has the following contribution to knowledge:

- The Basic Science Achievement Test (BSPT) was developed by the researcher to test students' academic performance in work, energy and power concepts and found to be effectual. Thus, unique in this field.
- The Hierarchical Concept mapping model developed by the researcher and used as a treatment for the experimental group was found to be very effective. Therefore contribute to knowledge.

- The findings of the research will add new information to the existing literature.

5.6 Recommendations

Based on the findings, the following recommendations were made:

1. The use of Concept mapping Instructional Strategy in teaching Basic science should be encouraged by stake holders in the education industries i.e both Federal and State Ministries of Education and other relevant agencies like STAN, NERDC among others. This can be achieved through periodic seminars and workshops to teachers on how to use Concept mapping for teaching basic science.

2. Curriculum Planners should examine the efficacy of Concept mapping Instructional Strategy and recommend it for use in translating the curriculum at the classroom level where appropriate.

3. No matter how effective certain method of teaching is; it may not yield the required result if the implementers of the method (the teachers) are not properly and adequately trained on how to use the method. It is therefore recommended that the Federal and State Ministries of Education should encourage teacher training institutions in the country (i.e secondary education) to regularly organize a training workshop for science teachers so as to provide them the technical know-how regarding the proper use of any novel approach to science teaching.

4. Textbook publishers should produce textbooks in science subjects using the BSPT model.

5.7 Limitations of the Study

The following are the limitations of this study:

- The study was restricted to only junior secondary schools in Zaria Education Zone of Kaduna State, this made the scope of generalization that can be made from this study fairly narrow. Thus, a limitation to the study.
- The use of a sample of size of only one hundred and twenty (120) is a limitation observed by the researcher. If a larger sample size is used for the study, it might wider the scope of generalization that can be made from the study.

5.8 Suggestions for Further Study

Based on the findings of this study the following suggestions may be found useful:

- That similar study could be conducted elsewhere to see whether it will yield similar or different outcome with the present study.
- That the study can be carried out in private schools, Boarding or Day school.
- A similar study may also be conducted in senior secondary school (SSS) level to find out the efficacy of Concept mapping Instructional Strategy on retention and academic performance of students in physics, Mathematics, chemistry and Physical and Health Education (P. H. E).
- The result obtained in this study was for concepts in basic science. The strategy can therefore be tried for other science disciplines like Biology, Mathematics, chemistry and Physics among others.

- More studies should be conducted on efficacy of Concept mapping Instructional Strategy on academic performance, gender, attitude and interest in secondary schools and tertiary institutions in different part of the country.

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APPENDIX A

BASIC SCIENCE PERFORMANCE TEST (BSPT)

TIME ALLOWED: 1HR

ATTEMPT ALL QUESTIONS

DO NOT START UNTIL YOU ARE TOLD TO DO SO

Name of School: _____

Male or Female: _____

INSTRUCTION: Tick (✓) the correct answers below.

1. Science makes the world a global village through
    a. agriculture
    b. drum
    c. electricity
    d. internet
2. The type of energy possess by a simple pendulum, when it is stationary?
    a. Kinetic energy
    b. Potential energy
    c. Sound energy
    d. Potential + kinetic energy
3. Name the physical quantity which is equal to the product of force and velocity
    a. work
    b. energy
    c. power
    d. acceleration

4. Science is developed in a society to provide all the

   Following EXCEPT

   a. communication

   b. food security

   c. smuggling

   d. transportation

5. Which of these is not a form of energy?

   a. Sound

   b. Light

   c. Pressure

   d. Mechanical

6. Advance application in science are as follows EXCEPT

   a. automobiles

   b. charcoal

   c. computer

   d. telephone

7. Work done = force x _____?

   a. distance

   b. acceleration

   c. velocity

   d. speed

8. Force is measured by a unit called?

    a. Joule

    b. Kelvin

    c. Ampere

    d. Newton

9. Electrical power is measured in

    a. ampere

    b. ohms

    c. volts

    d. watts

10. The S.I. unit of energy is

    a. amperes

    b. joules

    c. ohms

    d. volts

11. The product of force and distance in the direction of applied force is called …….?

    a. Velocity

    b. Work

    c. Power

    d. Pressure

12. 1 joule = 1 _____?

    a. N^{m2}

b. Kg m/m2

c. N m

d. N^2 M^2

13. All categories of people are expected to be _____ literate.

a. artistically

b. computer

c. scientifically

d. social science

14. When fuel is burnt, chemical energy is converted into _____ energy.

a. coal

b. heat

c. pressure

d. compound

15. The electric bulb converts electrical energy to _____ energy.

a. chemical

b. light

c. mechanical

d. solar

16. Which form of energy does the flowing water possess?

a. Gravitational energy

b. Potential energy

c. Electrical energy

d. Kinetic energy

17. The unit of power is _____?

a. Watt per second

b. joule

c. kilojoule

d. joule per second

18. A process by which chemical energy in a fuel is converted to heat is

a. boiling

b. burning

c. compressing

d. condensing

19. Electric pressing iron converts electrical energy to _____ energy.

a. chemical

b. heat

c. kinetic

d. mechanical

20. Power is a measure of the _____

a. rate of change of momentum

b. force which produce motion

c. change of energy

d. rate of change of energy

21. If the speed of an object is doubled then its kinetic energy is_____

a. doubled

b. Quadrupled c. halved d. tripled

22. A body at rest possesses _____ energy.

a. electrical

b. kinetic

c. mechanical

d. potential

23. The rate of doing work is called

a. energy

b. force

c. power

d. pull

24. By definition, work is done when a _____ moves through a distance?

a. mass

b. force

c. pressure

d. power

25. Energy can neither be created nor destroyed is a statement of the _____

a. law of conservation of electrical charges

b. law of conversation of matter

c. law of conservation of energy

d. law of conservation

26. Mechanical work is said to be done when a …… produces motion.

a. Power b. Energy

c. Pressure d. Forces

27. The common unit of work and energy is called ……..?

a. Joule

b. Meter

c. Watt

d. Newton

28. A carton is pulled along the ground for a distance of 9 metres. If the average frictional force is 28 N, then the work done is?

a. 28 J

b. 9 J

c. 2268 J

d. 252 J

29. The forms of energy obtained from burning of firewood includes:

a. Sound and electrical

b. Heat and light

c. Heat and chemical

d. Light and electrical

30. A simple machine often multiplies your?

a. energy

b. work

c. force

d. power

31. Energy is the capacity to perform ……?

a. Pressure b. Power

c. Work d. Force

32. The primary source of energy is …….?

a. Mechanical

b. Sun

c. Food

d. Water

33. Mechanical advantage can be defined as the ratio of?

a. Work input to work output

b. Work output to work input

c. Output force to input force

d. Input force output

34. Which source of energy listed below is in liquid form?

a. Charcoal

b. Coal

c. Petroleum

d. Wood

35. The following appliances convert electrical energy into heat energy EXCEPT electric

a. grinder

b. kettle

c. pressing iron

d. soldering iron

36. Potential energy is energy due to the;

a. Motion of an object.

b. speed of an object

c. Temperature of an object.

d. None of the above.

37. A force is regarded as _____

a. Roll or swing

b. Pool or cool

c. Push or pull

d. Dance or play

38. A rolling stone possesses _____ energy

a. Gravitational

b. Light

c. Potential

d. Mechanical

39. A lever rotates around a fixed point called a:

a. gear

b. pulley

c. fulcrum

d. ball bearing

40. The human arm is an example of which type of lever

a. first class

b. second class

c. third class

d. none of the above

APPENDIX B
Basic SciencePerformance Test (BSPT)
Marking Scheme

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

23. A

24. C

25. B

26. B

27. A

28. C

29. B

30. A

31. C

32. B

33. A

34. C

35. A

36. D

37. C

38. C

39. C

40. C

APPENDIX C

EXPERIMENTAL GROUP (GROUP A)

LESSON ONE WEEK ONE

Topic: Work

Method Concept Mapping

Subject: Basic Science

Class : JSSII

Gender: Male and Female

Duration: 40 min.

Instructional Materials: Card board paper and pins

Behavioral objectives: At the end of the lesson students should be able to;

i. Explain the concept work

ii. Use the formula power = work done/Time

iii. Explain the meaning of work done

iv. And state energy transfer that occur when work is done

Previous knowledge: Student were taught the human digestive system

Introduction: Teacher introduces the lesson by asking questions based on previous knowledge.

Presentation: The teacher introduces the lesson through the following steps;

Step I: teacher explains to the students the concept work.

Step II: grouping of students into five groups

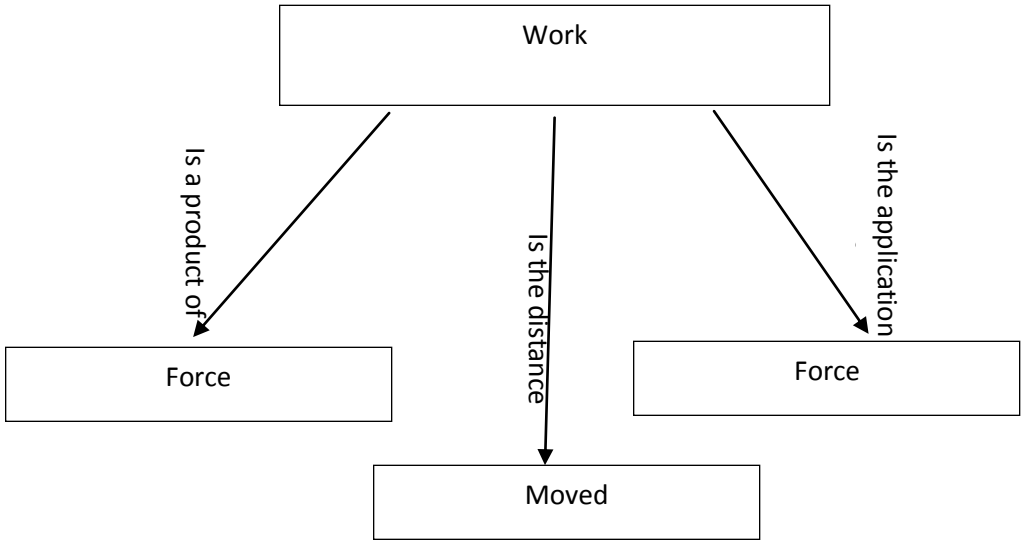
Step III: students' activities using hierarchical concept mapping on the chart provided.

Step IV: discussion with student based on the hierarchical concept map conducted.

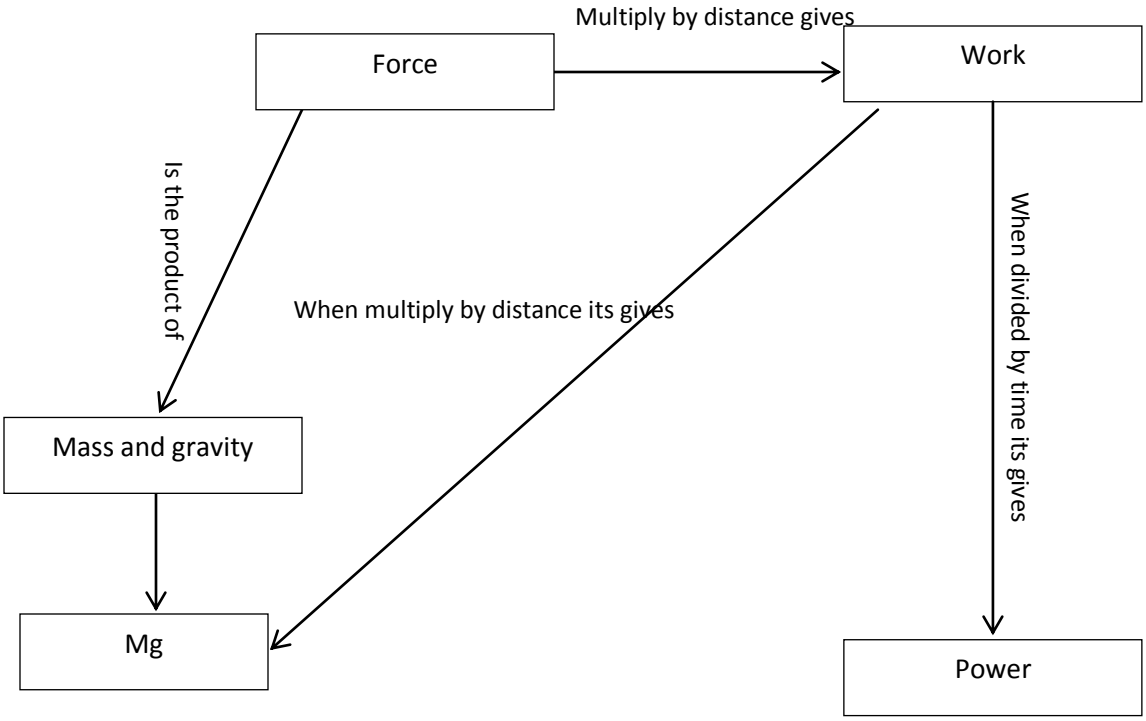
Evaluation: Teacher evaluate the lesson by setting more examples from the lesson discussed above i.e arranging the sub-topic and proposition then list them on the board then randomly call the students out to draw out their own concept map and cross-linking the terms. The teacher corrects where there is mistake.

Conclusion: The teacher conclude by giving assignment i.e the student should construct their own concept map using the concept sample and propositions given above.

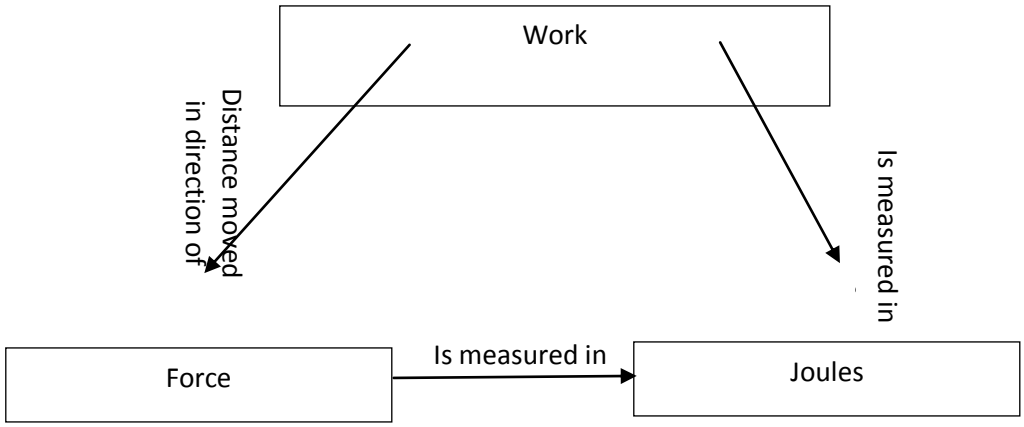
Presentation: Step 1



Presentation Step II



Presentation Step II



LESSON TWO WEEK TWO

Topic: Energy I

Method: Concept Mapping

Subject: Basic Science

Class : JSSII

Gender: Male and Female

Duration: 40 min.

Instructional Materials: Card board paper and pins

Behavioral objectives: At the end of the lesson students should be able to;

i. Explain the concept work

ii. Use the formula power = work done/Time

iii. Explain the meaning of work done

iv. And state energy transfer that occur when work is done

Previous knowledge: Student were taught the human digestive system

Introduction: Teacher introduces the lesson by asking questions based on previous knowledge.

Presentation: The teacher introduces the lesson through the following steps;

Step I: teacher explains to the students the concept work.

Step II: grouping of students into five groups

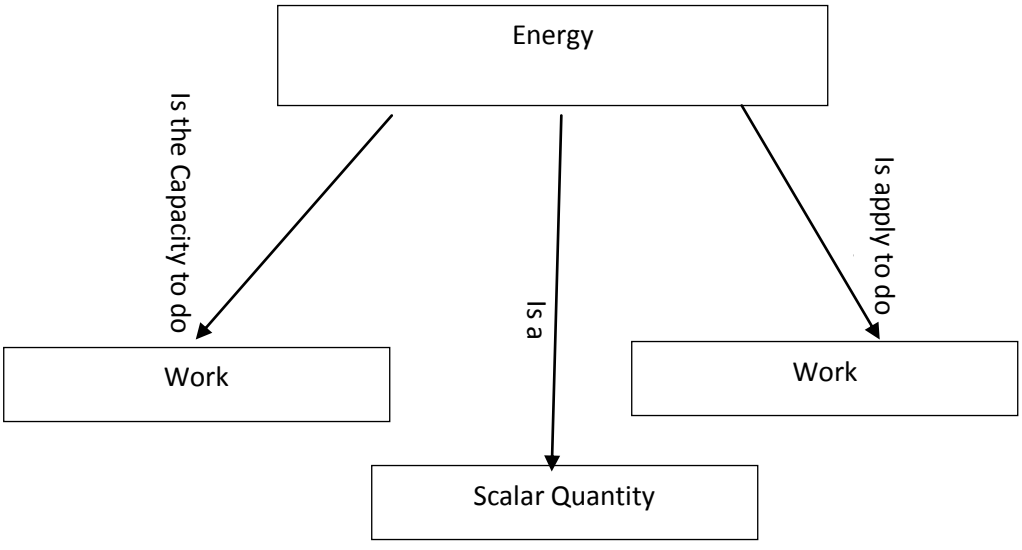
Step III: students' activities using hierarchical concept mapping on the chart provided.

Step IV: discussion with student based on the hierarchical concept map conducted.

Evaluation: Teacher evaluate the lesson by setting more examples from the lesson discussed above i.e arranging the sub-topic and proposition then list them on the board then randomly call the students out to draw out their own concept map and cross-linking the terms. The teacher corrects where there is mistake.

Conclusion: The teacher conclude by giving assignment i.e the student should construct their own concept map using the concept sample and propositions given above.

Presentation:**Step 1**



Activity 1: The students are grouped and giving each group subtopic in energy on a Cardboard paper.

Activity 2: The students studied the proposition and major words in the boxes.

Teacher Activity 1: The teacher asked the students to go back to normal class setting after interaction.

Teacher Activity 2: The teacher explained each subtopic on the board using the outline proposition matching with arrows to the corresponding meaning.

Teachers Activity 3: Teacher allows students to ask question on l the subtopic in energy.

Evaluation: Teacher evaluate the lesson by setting more examples from the lesson discussed above i.e arranging the subtopic and proposition then list them on the board then randomly call the students out to draw out their own concept map and cross-linking the terms. The teacher corrects where there is mistake.

Conclusion: The teacher conclude by giving assignment i.e the student should construct their own concept map using concept sample propositions given above.

Teacher illustrates potentials and kinetic energy. The type of energy possessed by a body due to its position is called potential energy, on the other hand, kinetic energy is the energy possessed by a moving body e.g. a moving car, a man running, a falling orange.

Teacher's Activity: Teacher throws a ball and count as the ball bounces and list the energy changes that occur in the process of bouncing.

Step III: Teacher states the energy transfer when work is done. When an object is dropped from above the ground, work is done as the object is pulled to the ground, the potential energy of the body is changed to kinetic energy.

Teachers Activity: Teacher writes more examples of work done and formula and allow students to copy what is on the black board.

Student activity: Teacher allow students to ask questions.

Evaluation: Teacher evaluate the lesson by asking the following questions:

i. Define work and energy,

ii. Explain the meaning of potential energy and kinetic energy.

Conclusion: The teacher concludes by summarizing the lesson.

LESSON THREE WEEK THREE

Topic: Energy II

Subject: Basic Science

Class : JSSII

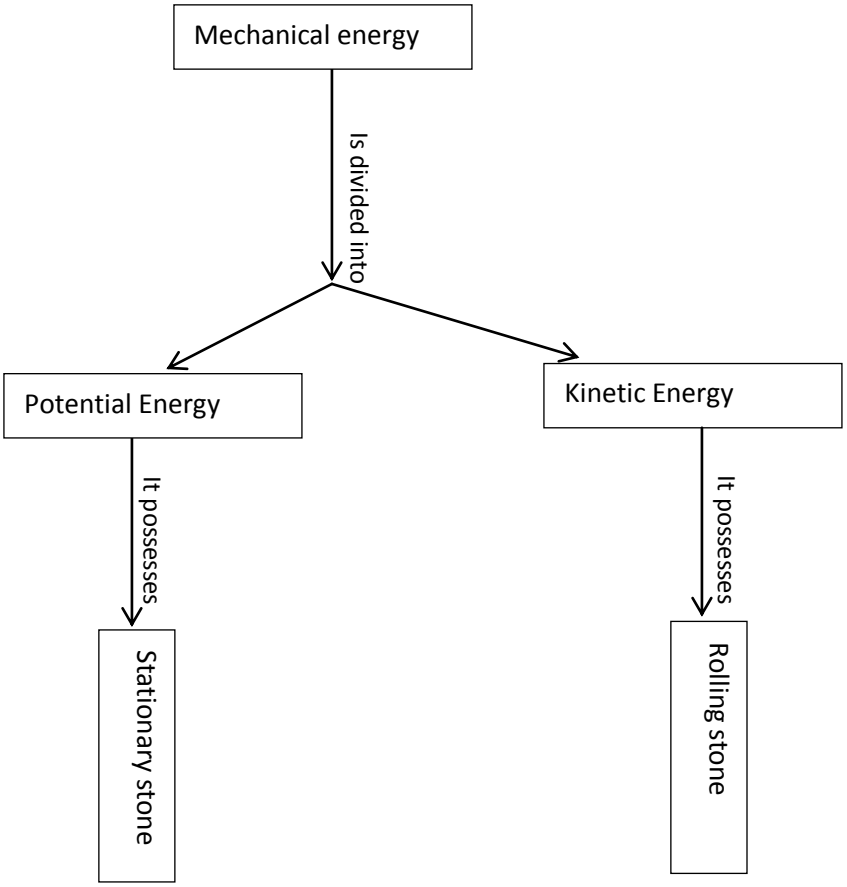
Gender: Male and Female

Duration: 40 min.

Teaching Materials: Card board paper and pins

Method: Concept Mapping

Presentation: Step 1



Activity 1: The students are grouped and giving each group subtopic in energy on a cardboard paper.

Activity 2: The students studied the proposition and major words in the boxes.

Teacher Activity 1: The teacher asked the students to go back to normal class setting after interaction.

Teacher Activity 2: The teacher explained each subtopic on the board using the outline proposition matching with arrows to the corresponding meaning.

Teachers Activity 3: Teacher allows students to ask question on l the subtopic in energy.

Evaluation: Teacher evaluate the lesson by setting more examples from the lesson discussed above i.e arranging the subtopic and proposition then list them on the board then randomly call the students out to draw out their own concept map and cross-linking the terms. The teacher corrects where there is mistake.

Conclusion: The teacher conclude by giving assignment i.e the student should construct their own concept map using concept sample propositions given above.

LESSON FOUR WEEK FOUR

Topic: Power

Subject: Basic Science

Class : JSSII

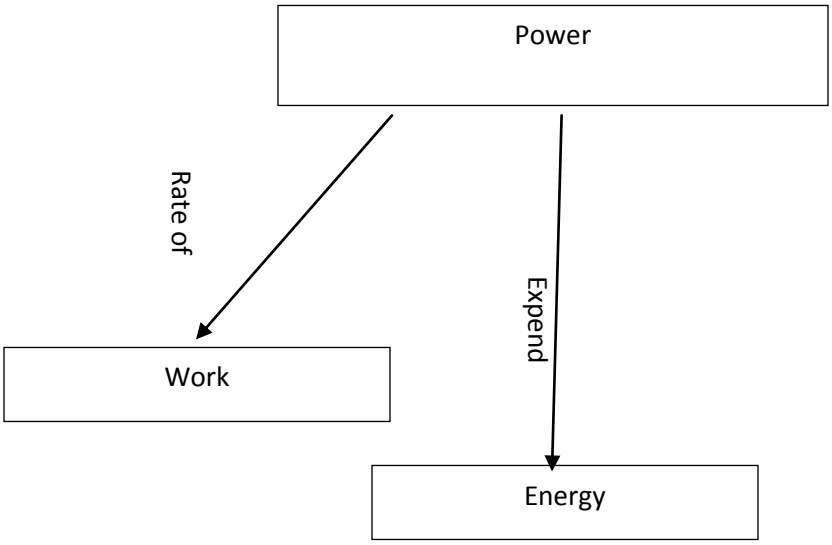
Gender: Male and Female

Duration: 40 min.

Teaching Materials: Card board paper and pins

Method: Concept Mapping

Presentation: Step 1



Activity 1: The students are grouped and giving each group subtopic in Power on a cardboard paper.

Activity 2: The students studied the proposition and major words in the boxes.

Teacher Activity 1: The teacher asked the students to go back to normal class setting after interaction.

Teacher Activity 2: The teacher explained each subtopic on the board using the outline proposition matching with arrows to the corresponding meaning.

Teachers Activity 3: Teacher allows students to ask question on l the subtopic in power.

Evaluation: Teacher evaluate the lesson by setting more examples from the lesson discussed above i.e arranging the subtopic and proposition then list them on the board then randomly call the students out to draw out their own concept map and cross-linking the terms. The teacher corrects where there is mistake.

Conclusion: The teacher conclude by giving assignment i.e the student should construct their own concept map using concept sample propositions given above.

APPENDIX D

CONTROL GROUP (GROUP B)

LESSON ONE WEEK ONE

Topic: Work

Subject: Basic Science

Class : JSSII

Gender: Male and Female

Duration: 40 min.

Teaching Materials: Chalk and Duster

Method: Lecture Method

Behavioral Objective: At the end of the lesson students should be able to;

v. Explain the concept work

vi. Use the formula power = work done/Time

vii. Explain the meaning of work done

viii. And state energy transfer that occur when work is done

Previous Knowledge: Students were taught the human digestive system

Introduction: Teacher introduces the lesson by asking questions based on previous knowledge.

The digestions of food takes place in stages in different parts of the digestive system, name them?

Presentation: The teacher introduces the lesson through the following steps;

Step I: teacher explains to the students the concept work.

Step II: the teacher solves a problem of work done using the formula given.

Step III: Teacher explains the Energy transfer when work is done.

Student activities: Teacher allow student to ask questions.

Evaluation: Teacher evaluate the lesson by asking the following questions,

i. Work can be defined?

ii. State energy transfer that occur when the work is done.

Conclusion: The teacher concludes the lesson by summarizing the lesson

LESSON TWO WEEK TWO

Topic: Energy I

Subjects: Basic Science

Class: JSSII

Gender: Male and Female

Duration: 40 min.

Teaching Material: Chalk and duster

Method: Lecturer method

Behavioral objectives: At the end of the lesson students should be to:

i. Explain the meaning of Energy
ii. Identify the components of Energy
iii. Describe the sources of Energy

Previous Knowledge: Students were taught work in previous lesson.

Introduction: the teacher introduces the lesson by asking questions based on previous knowledge i.e. what is work done?

Presentation: Teacher presents the lesson through the following steps;

Step I: teacher explains to the student the concept energy as the capacity to do work.

Step II: Teacher explains the various forms of energy. These are as follows:-

i. Solar energy,

ii. Heat energy

iii. Light energy

iv. Mechanical energy

Step III: Teacher explain common examples which illustrate relationship between work and energy and power e.g.

i. A rape mango falls off and drop on the head of a goat under the tree. What happen then?

ii. You are running and you suddenly increase your speed to overtake someone in front of you. Is any work done in increasing your speed.

Student Activities: Teacher allow student to ask questions.

Evaluation: Teacher evaluates the lesson by asking the following questions;

i. Define energy

ii. Name three sources of energy

Conclusion: The teacher conclude by summarizing the lesson.

LESSON THREE WEEK THREE

Subject: Basic Science

Topic: Energy II

Class: JSSII

Gender: Male and Female

Duration: 40 min.

Teaching Materials: Chalk and Duster

Method: Lecturing Method

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

i. Explain the concept energy.

ii. Use the formula: Power = work done/ time

iii. Explain the meaning of potential energy and kinetic energy.

iv. State energy transfer that occurs when work is done.

Previous Knowledge: Students were taught the sources of energy.

Introduction: Teacher introduces the lesson by asking questions based on previous knowledge;

i. Define the term Energy?

ii. Name two components of Energy?

Presentation: Teacher presents the lesson through the following steps;

Step I: Teacher explain to the students concept of energysi.e. work is a product of force and distance moved in a given direction, that is work = force (f) x distance (d) moved in the direction of the force.

Work done divided by time and energy has been defined as the capacity to do work.

Step II: Teacher illustrates potentials and kinetic energy. The type of energy possessed by a body due to its position is called potential energy, on the other hand, kinetic energy is the energy possessed by a moving body e.g. a moving car, a man running, a falling orange.

Teacher's Activity: Teacher throws a ball and count as the ball bounces and list the energy changes that occur in the process of bouncing.

Step III: Teacher states the energy transfer when work is done. When an object is dropped from above the ground, work is done as the object is pulled to the ground, the potential energy of the body is changed to kinetic energy.

Teachers Activity: Teacher writes more examples of work done and formula and allow students to copy what is on the black board.

Student activity: Teacher allow students to ask questions.

Evaluation: Teacher evaluate the lesson by asking the following questions:

iii. Define work and energy,

iv. Explain the meaning of potential energy and kinetic energy.

Conclusion: The teacher concludes by summarizing the lesson.

LESSON FOUR WEEK FOUR

Topic: Power

Subject: Basic Science

Class: JSSII

Gender: Male and Female

Duration: 40 min.

Teaching materials: chalk and dusters

Method: lecturing method

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

i. Define the concept power
ii. Differentiate contact force from force fields
iii. State the uses of force
iv. Explain harmful effects of friction

Previous Knowledge: Students were taught work, energy and power.

Introduction: Teacher introduces the lesson by asking questions based on previous knowledge.

Presentation: The teacher introduces the lesson through the following steps;

Step I: Teacher explain the concept of force that force is any action that moves an objects or alters it uniform motion in a given direction.

Step II: Teacher differentiates contacts force from force field i.e. contact force occurs between two bodies making contact with each other, which force filed include, magnetic force, gravitational force and electric force.

Step III: Teacher further explain the uses of force i.e. it is needed to make object move and friction car wheel from slipping on a tarred road when working on it.

Students Activity: Teacher allows students to ask questions.

Evaluation: Teacher evaluates the lesson by asking the following questions?

i. A force that slow down moving object is called ……?

ii. The force that acts through space is called ……..?

Conclusion: The teacher concludes by summarizing the whole lesson and given note to copy.

APPENDIX E

ITEM ANALYSIS OF MULTIPLE CHOICE QUESTIONS (BSPT)
TABLE OF DIFFICULTY AND DISCRIMINATION INDICES

Item	Key	RU	RL	P	P%	D
1	D	7	6	0.65	65	-0.14
2	A	7	5	0.60	60	0.29
3	C	7	7	0.70	70	0.00
4	C	5	3	0.40	40	0.29
5	C	7	4	0.55	55	0.45
6	B	6	4	0.50	50	0.29
7	A	5	3	0.40	40	0.29
8	D	6	1	0.35	35	0.71
9	C	5	4	0.45	45	0.14
10	B	6	3	0.45	45	0.43
11	B	6	1	0.35	35	0.71
12	C	2	3	0.25	25	-0.14
13	B	4	2	0.30	30	0.29
14	B	3	3	0.30	30	0.00
15	B	4	3	0.35	35	0.14
16	D	6	4	0.50	50	0.29
17	D	7	4	0.55	55	0.43
18	B	4	2	0.30	30	0.29
19	B	5	3	0.40	40	0.29
20	D	1	1	0.10	10	0.00
21	B	5	2	0.35	35	0.43
22	D	4	4	0.40	40	0.00

23	A	6	2	0.40	40	0.57
24	C	5	6	0.55	55	-0.14
25	B	2	4	0.40	40	-0.29
26	B	5	4	0.45	45	0.14
27	A	7	3	0.50	50	0.57
28	C	5	2	0.35	35	0.43
29	B	4	6	0.50	50	-0.29
30	A	5	3	0.40	40	0.29
31	C	7	6	0.65	65	0.14
32	B	6	5	0.55	55	0.14
33	A	6	2	0.40	40	0.57
34	C	6	4	0.50	50	0.43
35	A	3	3	0.30	30	0.00
36	D	3	3	0.30	30	0.00
37	C	5	4	0.45	45	0.14
38	C	0	0	0.00	00	0.00
39	C	7	4	0.55	55	0.43
40	C	1	2	0.15	15	-0.14