EFFECTS OF COLLABORATIVE LEARNING STRATEGY ON PERFORMANCE AMONG LOW ABILITY JUNIOR SECONDARY SCHOOL BASIC SCIENCE STUDENTS IN KANO, NIGERIA

BY

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

DEPARTMENT OF SCIENCE EDUCATION

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DECLARATION

I declare that this thesis entitled "Effects of Collaborative Learning Strategy on Performance among Low Ability Junior Secondary School basic science students in Kano, Nigeria" has been carried out by me in the Department of Science Education, Ahmadu Bello University, Zaria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

_____ _____

Umar ISHAQ Date

CERTIFICATION

This thesis entitled "Effects of Collaborative Learning Strategy on Performance among Low Ability Junior Secondary School Basic Science Students in Kano, Nigeria" by Umar ISHAQ meets the regulations governing the award of Masters Degree in Science Education, Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This piece of academic work is dedicated to my father, Ishaq Musa, my mother, Bilkisu Abdullahi, my wife Farida Mukhtar, my children Aisha Humaira, Amina and Mahmud I love you all and appreciate your individual inspiration and encouragement.

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ABSTRACT

This study investigated the Effects of Collaborative Learning Strategy on Performance among Low Ability Junior Secondary School Basic Science Students in Kano, Nigeria. Quasi Experimental pretest and posttest control group research design was adopted for data collection. Pretest was conducted on the two groups. After treatment, posttest was administered. The experimental groups were given treatment for six weeks, using collaborative learning. While the control group was exposed to teaching for six weeks using lecture method. The population consists of 6,715 students. A sample of 120 subjects of both experimental and control groups was selected. The instrument used for data collection was Basic Science Achievement Test. Simple random sampling using balloting method involving a pick from a hat, was used. The Basic Science Achievement Test has reliability coefficient of 0.78. Four null hypotheses were stated in line with the research questions. Data collected were analyzed using t-test statistics at $P \leq 0.05$ level of significance. The findings revealed that: there was a significant difference in the mean scores of experimental groups, with experimental group performing better. And there was a significant difference in the mean scores of female students. Both the male and female low ability students exposed to collaborative learning strategy performed better when compared to their counterparts' low ability students exposed to lecture method. It was recommended that curriculum planner's and basic science teachers to consider its suitability and in cooperate collaborative teaching strategy for the teaching of Basic Science concepts among low ability students.

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ABBREVIATIONS

BSAT - Basic Science Achievement Test

CL - Collaborative Learning

FME - Federal Ministry of Education

JSS - Junior Secondary School

JSSCE - Junior Secondary School Certificate Examination

NERDC - Nigerian Educational Research and Development Council

NISP - Nigerian Integrated Science Project

NTI - National Teachers Institute

NOUN - National Open University of Nigeria

PPMC - Pearson Product Moment Correlation Coefficient

STAN - Science Teachers Association of Nigeria

STAD - Standard Team Achievement Divisions

STS - Science-Technology and Society

OPERATIONAL DEFINITION OF TERMS

1. **Collaborative Learning:** Is an instructional method in which students work together in small groups toward a common goal, the group should be between four to five students, and the teacher/researcher act as a facilitator.
2. **Low Ability Students:** A student whose score falls below 40% in a given standardized test of cognitive ability in their school and may not be expected to achieve mastery or recall stored information (schemata) within a reasonable amount of time, such a student is said to be low ability student.
3. **Homogeneous:** Students of the same ability in the same class or group.
4. **Academic Performance:** Refers to how well a student recalls, performs, and masters either low, averagely or high in a class or group work done in a school setting.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

The enormous importance of science in the technological, economic and political development of nations globally explains why technological attainment is often used to determine the level of development of every nation. Mathematics, Science and Technology are essential tools for socio-economic and cultural development of any nation (Usman, 2006). Because of this, every nation is strategizing on how to develop Science and Technology to earn national recognition. The world is becoming a global village with every nation struggling to control the global market through technological innovations with capacity to attract global acceptance. Lawal, (2007) stated that, science and technology provides the foundation for wealth creation and advancement of quality life. Also Ajewole, (2005) stated that Science and Technology have for long been recognized as the instruments par excellence for nation building and wealth creation which made every country today craves for their advancement. Shu-Nu-Chang, (2007) stated that, the increase of scientific literacy in these years and therefore, in the current science and technology dominated society, shows that scientific literacy is considered an important goal of Science Education. By careful understanding of the above statements, science education can be considered a fundamental component of basic education, which prepares children to live in a world that is increasingly defined by science and technology.

The foundation of modern science education in Nigeria was laid between 1861 and 1897 when rudiments of science evolved and develop into full science course (Aliyu 1982).

By 1926, Nature Study had become a popular subject in some primary schools and teacher training colleges. Elementary Science was taught at the first government teachers' college in the north, where later a teacher training college, which specialized in teaching rural science, was established in Minna. The extent at which the subjects were covered was shallow due to inadequate teachers and resources. Post secondary institutions were opened for the study of science as a result of pressure by some nationalists who studied abroad. The first of its kind was Yaba Higher College established in 1934. It was aimed at providing of intermediate manpower in Medicine, Agriculture, Survey, Engineering and Teachers to teach basic science subjects in secondary schools according to National Open University of Nigeria, (NOUN, 2013)

According to NOUN (2013), The West African Examination Council took over the School Certificate Examination from Cambridge in 1950. However, before 1950 there was no science teachers union as a forum for teachers to exchange ideas, promote meaningful learning, advocate for acquisition of science process skills, scientific attitude, critical thinking and capacity to adapt their environment. From that period of time changes were introduced to reflect the need to indigenize the content and scope of education in Nigerian secondary schools. In an effort to popularize science in the schools, science teachers all over the country met on 30Th November 1957 to inaugurate the Science Teachers' Association of Nigeria. The Federal Government later established the Federal School of Science in Lagos in 1958. Although at that time, the main function of the West African Examination Council was to critically examine and revise existing syllabuses in the various science subjects As a result of this Jegede(1982) stated that Nigeria Integrated

Science Project (NISP) was born, in an attempt to teach science as a unified whole, and to inculcate the following skills outlined by Science Teachers' Association of Nigeria (1990):

- Observe carefully and thoroughly;
- Report completely and accurately;
- Organize information acquired;
- Generalize on the basis of acquired Information;
- Predict as a result of the generalizations;
- Design experiments (including controls, where necessary, to check the predictions);
- Use models to explain phenomena, where appropriate; and
- Continue the process of inquiry when new data do not conform to predictions.

This clearly shows that the Science Teachers Association of Nigeria is positively contributing toward development of science and technology for present and future generation in the country. In order to achieve these goals Universal Basic Education (UBE) was launched on 29th September 1999 by the Federal Government of Nigeria (FGN) to provide a fulcrum for achieving free, compulsory and nine year education for all school age children irrespective of their socio-economic circumstance (NOUN 2013). Federal Government in 2004 prescribed the inclusion of basic science in the curriculum of nine-year basic education as basic science and technology. Basic science, formerly known as Integrated Science, is the first form of science a child comes across at the junior secondary school level; hence basic science prepares students at the Junior Secondary School level for the study of core science subjects (physics, chemistry, biology) at the Senior Secondary School level (Olarewaju, 1994). Therefore for a student to be able to

study single science subjects at the Senior Secondary School level successfully, they must be well grounded in basic science at the Junior Secondary School level. In view of this, basic science is given great importance in the Junior Secondary School curriculum. The principal reasons why Nigerian Government emphasizes Basic Science teaching in Nigerian Secondary schools as stated by (FME,2004), is to develop interest in science and technology, to make students to apply their basic knowledge and skills in science and technology to meet the societal needs, and to make students take advantage of the numerous career opportunities offered by the study of science and technology, for the students become prepared for further studies in science and technology;

Basic Science is a subject whose curriculum was designed with the major goal to inculcate process skills and science attitudes in a learner at junior secondary school level. This calls for the use of appropriate teaching methods that would help achieve these objectives. Usman (2002) stated that Lecture method has been found to be more commonly used and inadequate to equip the students in learning. Therefore, lecture method solely used by teachers to teach students is inappropriate, because low ability students are usually left behind during the lesson. Although basic science curriculum was designed to enable students become literate in science and to lay sound foundation for their subsequent study of geography, physics, biology and chemistry at senior secondary school level as stated in the National Policy on Education (FME 2004).

Cyril (2012) stated that the introduction of Basic Science and Technology in school curriculum implies an attempt for a radical change in emphasis and focus. Cyril further stated that innovation in Basic Primary and Junior Secondary Schools in Nigeria is characterized by features of the national core curriculum which is the incorporation of

concept formation and process skill acquisition. Also Olarewaju (1994) found that Basic Science is child centered and emphasis is laid more on learning science as a process than as a body of knowledge. Basic Science also involves the basic training in scientific skills requirement for human survival, sustainable development and societal transformation (Dung and Udofia, 2010). Peni (2014) stated that thus themes of Basic Science reflect the relationship of the learner with component concepts to be learnt and his environment, for example; 'You and Technology.'

Gender issue is topical in Science Education, more so with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in science and technology (Ogunkola and Bilesanmi-Awoderu, 2000). In Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent (Arigbabu & Mji, 2004). This is a view to which Onyeizugbo (2003) has also mentioned in which he pointed out that "sex roles are somewhat rigid in Africa particularly in Nigeria where gender differences are emphasized". It is commonplace to see gender stereotype manifested in the day-to-day life of an average Nigerian. Because, certain vocations and professions have traditionally been regarded as men's: (medicine, engineering, architecture) and others as women's: (nursing, catering, typing, arts).Typically, parents call boys to wash cars, cut grass, fix bulbs, or climb ladders to fix or remove things, On the other hand, chores such as washing dishes, cooking, cleaning and so on, are reserved for the girls. In a nutshell, complex and difficult tasks are allocated to boys, whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the larger society tended to see girls as the "weaker sex". Consequently, an average Nigerian child goes to school with these fixed stereotypes. Gender issues, both on

the part of the teachers and students, have been documented to affect achievement generally (Erinosho, 2005; Kennedy, 2000). Also in study conducted by Mari (1994), Bichi (2004), Adedayo (2004) and Atadoga (2005), they reported no significant difference in the performance of boys and girls. Although this lack of significant difference was due to active interaction between teacher and students gender difference, despite the fact that girls are generally shy and do not want to communicate in public (Rekha and Fisher 2004). This is what urges me to conduct this study to find out if there are significance differences between male and female low ability Basic Science students when taught using collaborative learning strategy.

In Nigeria, Basic Science teaching a number of problems among which are poorly trained teachers, inadequacy in pedagogy and content knowledge, and ill-equipped laboratories, assessment techniques (Ibe, 2008). Most teachers of Basic Science have their specialization in Biology, Chemistry, Physics, Geography and Agricultural science respectively and tend to teach only content areas related to the areas of their specialization. This problems of teaching and learning of science is not only in Nigeria, because Dzama and Osborne (1999) reported the abundant poor performance in science in developing countries, which is not just due to the students inability, but due to the absence of supportive environment such as teacher/students verbal interaction for serious science learning. A teacher has to introduce methods to develop students' scientific understanding, thinking and problem solving abilities, such would help in solving conceptual problems and results in high achievement in science, than the conventional lecture method which tends to emphasize knowledge and ignores higher order thinking (Usman, 2007). There is the need for Nigerian science teachers to develop more effective teaching strategies that

can enhance high students' achievement and improve the quality and quantity of discourse during the science lesson (Abdullah, 1998).

The search for improved strategies for teaching and learning of science is therefore a continuous process. That is basically what triggered the need for this study, and to find out whether or not collaborative learning strategy will enhance the academic achievement of low ability Basic Science students. One of the most successful methods of helping students learn actively is collaborative learning strategy. It has been clearly stated by researchers like Kaufman, (2000), Olorukooba, (2001), Slavin, (2007) and Dyel (2011) that when it is used, students tend to exhibit higher academic performance, critical thinking skills and deeper understanding of learned materials among others. Gokhale, (1995) defined Collaborative learning as "an instructional method in which students work together in small groups toward a common goal". Students who engage in collaborative learning are responsible for each other's learning as well as individual, and as a result, the success of one student assists other students to succeed. Thus, collaborative learning entails the formation of an informal setting, whereby students work collaboratively on a particular task, to analyze, synthesize and evaluate problems together, facilitate discussion and interaction.

Despite the importance of collaborative teaching and learning strategies, low ability basic science students are not carried away, in which Bani (2012) stated that there is an increase in the number of low ability basic science students. Most of the science teachers adopt the use of traditional method of teaching like lecture method, which brings about the total negligence of low ability learners (Usman, 2007). Emily, Robert, and Michael, (2003) found that if students are grouped homogeneously, there is the fear that low-ability

students will be deprived of opportunities to learn i.e. they may be left behind and also unmotivated to learn because of peer, personal and teachers' expectations of poor performance, as low ability students learn very slowly. This study therefore seeks to determine if collaborative learning strategy enhances learning among low ability learners, or not. It will also identify peculiar problems that low ability students face in teaching and learning and potent solution. Although, Aliyu, (2002) stated that the way basic science is taught without adequate provision taken to ensure low ability students weakness in learning is catered for through the use of effective mechanisms and the right instructional method. Esther (2012) defined low ability students as those whose score falls below 40% in a given standardized test of cognitive ability in which students in this category may not be expected to achieve mastery or recall stored information within a reasonable amount of time; such students are considered low ability students.

Scholars like Cused, (1990) Alderman, (2000), Lauri, (2002), and Young, (2008), have conducted studies involving collaborative learning; they separately found that when students participate in collaborative learning activities their performance and retention of learned material is improved. Therefore, this study aims to investigate the effects of collaborative learning strategy on academic achievement of low ability among junior secondary school students of Basic Science. Despite the efforts by various scholars for instance, Srinivas (2010), Panitz (2013), Chris Watkins (2013), carried out to investigate the effect of collaborative learning strategy, an extensive study is yet to be carried out with low ability students. Therefore, the purpose of this study is to examine the effects of collaborative learning strategy at improving academic achievement of low ability learners in basic science.

1.1.1 Theoretical Framework

Constructivism is a contemporary instructional theory whose pedagogical potentials in promoting meaningful learning are rapidly receiving the attention of educationists and researchers. Constructivist views learning as a process in which students actively construct their knowledge of the situation at hand based on the little knowledge the learner has (Oyedekun, 1998).

As a constructivist strategy, collaboration has roots in both Piagetian and Vygotskian views of learning. Piaget believes that children construct knowledge as they develop and repeatedly interact with their surrounding world (Piaget, 1926). The main implications of Piaget view in education is that children do not just take what is being said, instead, interpret what they hear in the light of their own knowledge and experience. To Piaget, knowledge is no information to be delivered at one end, and encoded, memorized, retrieved, and applied at the other end. Instead, knowledge is experience acquired through interaction with the world, people and things.

Vygotsky often spoke on collaboration as a teaching-learning phenomenon. It has been further researched as a learner-to-learner activity and peers at similar levels of knowledge might interact (Mercer, 1996, Jeong & Chi, 2007; Smith, Wood, Adams, Wieman, Knight, Guild, & Su, 2009). Vygosky is a social constructivists, his theory is on constructive social framework in which he emphasized that learning is a continual movement from lower to higher intellectual level. The application of constructivism in teaching and learning is that, the constructivist teaching and learning is based on constructivist learning theory. This theoretical framework holds that learning always

builds upon knowledge that a student already knows; this prior knowledge is called a schema.

A wide variety of methods like guided discovery, peer tutoring, cooperative and collaborative learning etc where the teacher avoids most direct instruction and attempts to lead the students through questions and activities to discover, discuss, appreciate, and verbalize the new knowledge are geared toward the constructivism theory. Gray (2007) stated that constructivist classroom has the following characteristics,

- The learners are actively involved
- The environment is democratic
- The activities are interactive and student-centered
- The teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

Mason (1998) found that when learners collaborate they explain, discuss, and sometimes justify their opinions about concepts to each other so that they develop a more generalized and principled understanding of the concepts under discussion, thus facilitating their own construction of meaning. In view of the above statements therefore, the study of collaborative learning strategy is used in this study.

1.2 Statement of the Problem

The ability level of students is the construct of their academic achievement (Aremu, 2001). Salami (2000) discovered that students' achievement depends on their cognitive ability. Studies have shown that learners are different in their ability levels and in learning problems (Adesoji, 1997; Chang & Mao, 1998; Iroegbu, 1998). In order to help those low ability learners among students of different ability levels to improve more, a suitable

method of instruction is needed. Based on the above statement, Iroegbu (1998) ascertained that method of instruction could improve the academic achievement of students with low ability levels. The number of low ability students in developing countries like Nigeria is worrisome (Akinlaye, 1998). The low ability students are usually stigmatized, uncared in a class setting, and were denied the opportunity to receive attention due to the teacher from the general assumption of the teachers that all is well with all members of the class. They are also unmotivated to learn because of the personal fear of poor performance. The great challenge to a science teacher is teaching a child who is a low achiever. It is an admitted fact that every class has a composition of 20% to 30% or more low achievers. The low achievers students do not fall into category of special education children as they do well outside the classroom and show no evidence of having a medical problem, they simply do poorly in science and mathematics subjects as reported by Yushaʻu, (2012).

Okebukola (1984) confirmed that the use of appropriate instructional strategies could influence the performances of low achieving students. He further stated that there is need to redirect efforts towards knowing more about the interactions between our environment and science teaching. Collaborative learning is a learning strategy where students have the opportunity to share ideas and interact with students of the same or with varied ability in order to get experiences. The interactions are expected to enhance their performance, build-up their self-importance, stimulate them to inquiry and make ideas clear. Thus, they are expected to surmount some of their learning difficulty and this study is aimed at establishing performance if it can be enhanced as they engage in collaborative instruction.

Studies conducted by Petal (2003), Rekka and Fisher (2004), Ibrahim (2008), and Olajide (2002), showed that teacher-students interaction influences academic achievement of students. Laurie (2003) found that collaborative working groups in completing the work takes 15% longer compared to working individually. However, the resulting product has a collaborative group of higher quality levels than individual work. Collaborative learning enhances critical thinking, among students in-group than those who studied individually (Gokhale, 1995). Lakpini (2012) found that collaborative learning increase students' academic performance, and students perform low when taught using traditional method.

Based on the findings of the above researchers, it shows that collaborative learning when practiced will help to improve student's academic performances. This study intends to find out the effect of collaborative learning strategy on academic performance of junior secondary school students of low ability in basic science concept in Fagge local government education authority, Kano State, Nigeria.

1.3 Objectives of the Study

The study has the following objectives to;

1. Consider and examine the difference in the academic performance of low ability students taught using collaborative learning strategy and those taught using lecture method.
2. Compare the academic performance of male and female junior secondary school class two students of low ability in Basic Science taught using collaborative learning strategy.

3. Compare the academic performance of female Basic Science low ability students taught basic science using collaborative learning strategy and those taught using lecture method.
4. Compare the academic performance of male low ability Basic Science students taught basic science using collaborative learning strategy and those taught using lecture method.

1.4 Research Questions

The aim of this study is to answer the following research questions;

1. What is the difference in the academic performance of low ability students taught basic science using collaborative learning strategy and those taught using lecture method?
2. What is the difference in performance of low ability male and female junior secondary school two students taught basic science using collaborative learning strategy differ or not?
3. What is the difference in the academic performance of female low ability students taught Basic Science using collaborative learning strategy and those taught using lecture method?
4. What is the difference in the academic performance of male low ability students taught Basic Science using collaborative learning strategy and those taught using lecture method?

1.5 Null Hypotheses

The following null hypotheses are formulated to be tested at $P \leq 0.05$ level of significance.

HO_1 There is no significant difference in academic performance of low ability students taught basic science using collaborative learning strategy and those taught using lecture method.

HO_2 There is no significant difference in the academic performance of male and female junior secondary school two students of low ability taught basic science using collaborative learning strategy.

HO_3 there is no significant difference in academic performance of female low students taught Basic Science using collaborative learning strategy and those taught using lecture method.

HO_4 there is no significant difference in academic performance of male low ability students taught Basic Science using collaborative learning strategy and those taught using lecture method.

1.6 Significance of the Study

The findings of this research study would be of use to the improvement of science education in the following ways:

1. The results of this study would provide an inclination of the possibility of using collaborative learning strategy to enhance academic performance of low ability students. Since collaborative learning involves group activity, this research provided the students on how to interact with their peers of either same academic ability (low ability) or those with different academic ability that is high and average such as varied abilities. Also, those low ability learners who are exposed to collaborative learning strategy, their academic performance and critical thinking would improve.

2. The study would helped government at different levels. For examples, it will profer suggestions to the Federal, State and Local governments on how to instruct teachers in using this learning strategy at all levels of learning, such as primary, secondary and tertiary level of education. For other professional associations such as Nigerian Educational Research and Development Council (NERDC), Science Teachers Association of Nigeria (STAN), the research will offer them advance on how to carryout seminars, workshops and other research activities to help, implement and communicate these learning activities to teachers and educationalist in order to acquaint themselves with effective learning package, and to promote science instruction in schools.
3. The finding of this research work would provide curriculum planners, educational administrators to make reference in review of curriculum and formulating other educational policies where necessary. This would validate and add value to the existing theory of collaborative learning strategy.

1.7 Scope of the Study

This study was carried out to determine the effects of collaborative learning strategy on academic performance among the low ability basic science students in Fagge Local Education Authority of Kano State. This study was limited to:

1. Junior secondary school II students of low ability in Basic Science in Fagge Local Government Area of Kano State in public schools.
2. The subjects of the study are junior secondary JSS II Students of Basic Science from Junior Secondary Schools in Fagge Local Education Authority of Kano State. Because Fagge Local Education Authority is chosen because it is one of the seven local

education areas with the highest number of schools in Kano State. JSS III and JSS I students are not included in this study because JSS III are about to conduct their final exams and the JSS I are newly admitted, thus are yet to adapt to the school environment.

3. The topics to be covered are limited to work, energy, power and simple machine drawn from Nigerian Basic Science Pupils Book II (UBE), 2009 edition. Based on the pilot study conducted in this study area and interview with Basic Science teachers, it is discovered that the low ability students have problems of learning this subject because it involves some aspects of calculations. The topics used are work, energy and power, which Okoli (2006) and Ibe (2008) found are the basic science topics which students fail, while simple machines wheel, axle and gear contains many activities.
4. The basic science achievement test was used for this study, which contained twenty questions.

1.8 Basic Assumptions

This study is based on the following assumptions;

(1) The students used for this study were taught science through other instructional methods such as lecture method but not exposed to collaborative learning based on instruction in teaching Basic Science.

(2) The topics selected and used for this study simple machines, power, energy and work are appropriate to study subjects at junior secondary school two level (JSS II), and all the schools used for this study use the same curriculum.

(3) It is also assume that the schools used for this study have qualified basic science teachers.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, an attempt is made to examine the related literatures to this study. They are discussed under the following subheadings:

- Basic Science Philosophy and Objectives
- Current Trend in Basic Science
- Science Teaching Methods
- Collaborative Learning Strategy
- Essential Characteristics of Collaborative Learning
- Models of Collaborative Learning Strategy
- Similarities between Collaborative and Cooperative Learning
- Collaborative Learning Strategy and Academic Performance in Science
- Concept of Low Ability
- Motivating Low Ability Learners
- Relationship between Collaborative Learning and Academic Performance among students of Varied Abilities
- Collaborative Learning and Academic Performance
- Gender Differences and Performance in Science
- Overview of Similar Studies on Collaborative Learning Strategy
- Implications of Literature Reviewed on the Present Study

2.2 Basic Science Philosophy and Objectives

The term ‘‘Science’’ was defined by different people, among which are, Datom (2012) who defined it as a systematized body of knowledge about the universe and the process of enquiry for obtaining and building up knowledge of natural phenomenon, first by observations and utilization of individual’s mental powers or process to mediate on the data in order to generate meanings or new information.

Sulaiman (2013) stated that, the history of Basic Science in Nigeria dated back to 1969 when Science Teachers Association of Nigeria (STAN), Comparative Education Study and Adaptation Centre (CESAC) and Nigerian Educational Research and Development Council (NERDC), Formed Science Curriculum Development Committees, with numbers drawn from STAN, CESAC, Ministries of Education and Colleges of Education with a view to produce syllabuses for Integrated Science, Biology, Chemistry and Physics (Balogun, 1990). Sulaiman further stated that this led to the development of the Nigerian Integrated Science Project (NISP) by STAN. This was followed by joint working sessions of representatives from the three committees to make an attempt at integration of those disciplines (Mammam and Adamu, 2013). Mammam and Adamu further stated that working sessions formulated the philosophy, methodology, evaluation procedures and the integrating themes for what is now known as the Nigerian Integrated Science Project (N.I.S.P.). After 18 months, a final draft was accepted and approved at a seminar held in Lagos in December 1969, which formed the STAN’s curriculum development newsletter No.1, January 1970. The newsletter No.1 embodied an integration science course, which contained guidelines for effecting such a course for the junior forms of the secondary school as the association then saw it.

At stage, STAN got into a financial difficulty; this led to an agreement that the association should seek the collaboration of a reputable publisher who would be prepared to support the writers' workshops necessary for the production of curriculum materials. Mr. Akin Osiyale, a Lecturer at the Collage of Education, University of Lagos, was appointed as Director of the Nigerian Integrated Science Project and invited tenders from Nigeria-based publishers. The materials produced received professional editing by the publisher, and critical attention of an advisory panel of the association.

The philosophy behind basic science teaching and learning in Nigeria is in line with what the National Policy on Education upon which Mammam and Adamu (2013) stated that, science education emphasizes the teaching and learning of science process and principles. This included;

(i) To cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy;

(ii) To produce scientists for national development;

(iii) To provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life. etc

The philosophy behind basic science project stated that learners should be taught "what science is and how scientists work". In this philosophy, the learner should be exposed to much aspect of sciences as much as possible. To teach what science means to make the learner understand it as a body of accumulated knowledge and the process of gathering knowledge. To learn how the scientist work and his skills and attitudes used in gathering knowledge. This also involves the social environment in the surrounding of the scientist, and how they interact with the environment.

Sulaiman (2013) stated that the principal objectives why Nigerian Government started basic science teaching in Nigerian secondary schools are;

(i) To provide students at the Junior Secondary School level a sound basis for continuing science education either in single science subjects or further integrated science.

(ii) To enhance the scientific literacy of the citizenry.

(iii) It allows students to understand their environment in its totality rather than in fragments.

(iv) To allow the students to have general view of the world of science.

(v) To make the process of science serves as unifying factor necessary for the learner to know these processes through integrated approach of learning science.

In order to achieve these aims, the Federal Ministry of Education developed core curricula for primary integrated science and mathematics toward achieving the implementation of Nigerian Primary Science and Mathematics Project (NPSMP), (Sulaiman, 2013). The NPSMP has an integrated science curriculum which is a teaching curriculum that was organized into columns of topics, performance objectives, activities and assessment questions. The curriculum has the following objectives; pupils should be able to:

A. Observe and explore the environment;

B. Explain simple natural phenomena;

C. Develop scientific attitudes such as curiosity, critical reflection and objectivity;

D. Apply skills and knowledge gained through science to solving everyday problems in the environment;
E. Develop self-confidence and self reliance through problem-solving activities in science;
F. Develop a functional awareness and sensitivity to the orderliness and beauty in nature (Sulaiman, 2013).

Because of the worldwide curriculum reforms and recognition of the changing needs of the Nigerian students, the West African Examination Council (WAEC) invited STAN to review and recommend necessary reforms in the science syllabuses, which led to the setting up of subject panels that developed curricula in various science subjects, basic science inclusive with activity approach as teaching method. The curriculum of basic science has the following objectives:

i. To ensure that those students who may not study science at higher level have basic scientific skills and concepts in science that will see them through;
ii. The students should also be scientific literate and possess scientific attitudes, so as to fit in well with the changing needs of scientific era. The curriculum of Basic Science was face with the problem of inadequate and qualified teachers and the appropriate methods of instructional materials for teaching the subject. (Sulaiman, 2013).
iii. The curriculum also lays emphasis on concepts and processes of science and the skills associated with them (FME, 2004).

Atanda and Bello (2009) stated that basic science scheme has helped in the modifications of the Nigerian education system from 6-3-3-4 to 9-3-4; this was intended to

reduce drastically the incidence of drop out from the formal school and ensuring acquisition of appropriate levels of literacy, numeracy, manipulative, communicative and life skills for laying a solid educational foundation. The Universal Basic Education (UBE) in 1999 called for redesigning the curriculum in terms of teaching strategies and adequate supervision of instructional programs in the schools (Ayo and Adebiyi, 2008). Sulaiman (2013) stated that Basic Science is a revised curricula for primary and junior secondary school integrated science. It lays emphasis on inquiry into the nature of the environment through the use of scientific method of inquiry that include the ability to formulate questions to identify variables and design experiments, to interpret results, recognize patterns, generate hypothesis, draw conclusions and develop theoretical models. Sulaiman further stated that in selecting the contents of Basic Science curriculum, three issues shaping the development of nations and influencing the world of knowledge today were identified as globalization, information / communication technology and entrepreneurship. Four approved areas of curriculum innovations were infused in the Basic Science Curriculum, these are;

1. Environmental Education (EE)
2. Drug Abuse Education (DAE)
3. Population and Family life Education (POP/FLE)
4. Sexually Transmitted Infection (STI, HIV/AIDS)

Based on the above statements, Olarewaju (1994) in Sulaiman (2013) stated that Basic Science is child-centered and emphasis was laid more on learning science as a process than as a body of knowledge. Therefore, collaborative learning as an activity

learning strategy would be used to help low ability basic science students to overcome their problems.

2.3 Current Trend in Basic Science

The implementation of Basic Science in the junior secondary schools in Nigeria has been a matter of serious concern to educators. This is because it is taught as a core course at the junior secondary school level, which occupies unique position in junior secondary school curriculum (Shaibu, 2013). Based on the above assertion, the Federal Ministry of Education (FME, 2004), stated that the core-curriculum for basic science from JSS I – JSS III emphasized the need for planned learning experience to be child-centered. The design of the core-curriculum of basic science also includes some basic assumption, and they are :

1 The newly enrolled pupils in the junior secondary school programme had no prior knowledge of science.

2 The basic professional qualification for those who will teach the course will be the Nigeria Certificate in Education (NCE).

With reference to the National Policy on Education FME (2004), the teaching of basic science from the pre-secondary through the junior secondary school levels is intended to achieve the following aims:

i. Inculcate in the learners, the spirit of inquiry and creativity through exploration of nature and local environment.

ii. Laying sound basis for scientific innovation and reflective thinking.

iii. Develop in the child the ability to adapt to the child's changing environment.

iv. Give the child opportunities for developing manipulative skills that will enable the child to function effectively in the society within the limits of the child's capacity.

v. Provide the child with basic tools for further educational advancement including preparation for trades and crafts of the locality.

Based on these guiding principles, basic science course is to teach beginning with the understanding of the meaning of science and how the scientist works; since it is an activity based programme. Thus, basic science has come to be a core subject in the Nigerian junior secondary schools system. Datom (2012), stated that basic science serves as a base for further scientific study in higher levels of education and consequently, transformation of the Nigerian society through science and technology. In addition to these, Usman (2010), found that among the problems militating against the appropriate teaching of basic science are. Lack of appropriate teaching methods and aids, lack of specialized trained and qualified teachers in basic science. Usman (2010), stated that basic science objectives are still difficult to achieve due to so many factors, such as teacher related factors, attitude of teachers and students toward basic science. However, the use of appropriate teaching strategy and lack of instructional materials is another contributing factor. Therefore collaborative learning have been employed for the purpose of improving the teaching and learning of basic science using low ability basic science students at junior secondary school level.

2.4 Science Teaching Methods

The Teacher's Registration Council handbook, as cited in Molagun and Taiwo (2004), defines teaching as a systematic process of transmitting knowledge, attitudes and

skills in accordance with professional principles. Also according to James (2004) in Mbah (2012), teaching is the degree to which the teacher imparts knowledge to students. Adamu (2008) in Mbah (2012), defined method as a procedure by which a goal is reached, a purpose accomplished or a result achieved. Method is also defined by Mbah (2012) as a practical application of teaching principles based on the nature of learner, the nature of the subject and the learning needs of the pupils/students.

Although, there are different types of science teaching methods, however the traditional mode of teaching is the teaching method commonly used by most teachers in Nigerian schools from the primary to tertiary level of education. This method is teacher-centred and characterized by the teacher talking to the class most of the time while the students listen and take down notes and occasionally ask questions. Belcher (1996) sees knowledge as a commodity, which can be transferred by the act of teaching from one "container" to another. In most science classes, teachers assume that when a subject is verbally taught with the aid of textbooks and chalkboard it will definitely be understood and learned by students who have heard or read the teachers notes (Samba 1998; Oyedekun, 1998; Lakpini, 2006). However, Yusuf (2012) stated that some of the science teaching methods commonly used by teachers, includes.

- Lecture method
- Discussion method
- Demonstration method
- Laboratory/experimental method
- Field trip method
- Assignment method

■ Play-way method

■ Peer teaching method

■ Role playing method

■ Project method

■ Discovery method

Each of these methods has its advantages and disadvantages when used by the teacher. However science education researchers are of the view that method that involves learners, that is learner-centred is better for encouraging better learning, where the teacher centred method, that is lecture method, does not encourage effective learning.

2.4.1 Lecture Method

Lecture method is the method of teaching whereby the students listen to the teacher and take down notes. Yusuf (2012) stated that lecture method can be referred to as the technique that involves the teacher in complete verbal instruction or exposition. The teacher in this method tells his class what he feels they should know, the students listen and take down notes. The students are always passive while the teacher is active. She further stated that only one-way channel of communication is from teacher to students but the seating arrangement is usually centralized and the teacher is the focus of attraction. She concluded that, this method is appropriate for higher-level student's e.g tertiary level students.

Lecture method is deployed to teach a large group of students who are often passive listeners with little or no opportunity to ask questions, it is more appropriate for higher-level students Maduewesi (1999). Yusuf (2012), stated that Lecture method has so many advantages among which are; it is economical in terms of time effort, it allows the

teacher to cope with a very large number of students at a time, and it leads to easy coverage of the syllabus or course outline. Finally, this method encourages the habit of listening and it makes students develop the habit of writing fast. Despite these advantages of lecture method, studies shows that the main disadvantage of lecture method is that, it leads to the low achievement of students' performance (Usman 2000, 2006, and Stanley 2008). Other disadvantages of lecture method include the following: It is teacher-centered instead of pupils centered, the students are usually passive, eager to be spoon-fed by the teacher; it is not appropriate for teaching at nursery, primary and secondary school; it does not recognize individual differences; it does not cater for them; it is a fast method of teaching and thus places the slow learners at a disadvantage; it does not develop their initiative, and also the method appears to recognize the teacher as an encyclopedia of knowledge (Yusuf, 2012). Nowsu, (1993) and Okoli (2006) indicated that an overwhelming majority of science teachers prefer the lecture method of teaching and therefore shy away from innovative activity methods.

On the academic performance of students, Bichi (2002) and Usman (2008) have separately observed that lecture method encourages rote learning without understanding, thereby resulting in poor performance. Also students are not expressing their potential in the lesson, (Mbah, 2012). Obeka (2010) conducted a study and found that students perform significantly low on retention and achievement when taught with lecture method. In another study conducted by Usman (2010) in Zaria Local Government Area of Kaduna State found that students do not performing better when taught with lecture method. In view of this, the researcher wishes to conduct a study using collaborative learning among low ability basic science students with a view of finding solution to these problems.

2.5 Collaborative Learning Strategy

Educators have long used collaborative learning approaches in teaching and assessing students. More recently, educators and policy makers have identified the ability to collaborate as an important outcome. Therefore, collaborative learning becomes a focus of research in education during the past decade and even in the present days. Collaborative learning refers to an instructional method in which students at various performance levels work together in small groups toward a common goal. The students are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful (Gokhale, 1995).

Collaborative learning requires learners working together to achieve a learning goal. Collaborative learning is an instructional strategy that establishes a relationship among learners and promotes positive interdependence among the grouped learners (Srinivas, 2010). Roschelle and Teasley (1995) defined collaborative learning as a process by which individuals negotiate and share meanings relevant to the problem-solving task at hand. Collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem. Bonwell and Eison (1991), see collaborative learning as a strategy that involves students in doing things and thinking about the things they are doing "collaborative learning emphasize the active participation of learners, and this bring to mind the Chinese proverb; "Tell me and I forget, Show me and I will remember, Involve me and I will understand".

Collaborative learning creates an environment where the teacher involves students in doing things and thinking about the things they are doing and reaches students who otherwise might not be engaged. Collaborative learning encourages active student

participation in the learning or small group learning. In collaborative classrooms, where every student learns from everyone else, no student is deprived of the opportunity for making contributions and appreciating the contributions of others. (Stephen, Sandeep, Fariaz Karim, Sheikh, Yu Wang, and Bin Wang, (2013), stated that Collaborative classrooms have the following four general characteristics:

(1) Sharing knowledge: Teachers have vital knowledge about the course content, skills, and instruction, and provide that information to students. In a collaborative classroom, the teacher also builds upon the knowledge, personal experiences, language, strategies, and culture that students bring to the learning situation.

(2) Sharing ability: In a collaborative classroom, the teacher encourages students on the use of their own knowledge, ensures that students share their knowledge, expertise and their learning strategies, treat each other respectfully and focus on high levels of understanding.

(3) Mediation: In a collaborative classroom, teachers act as mediators to adjust the level of information since successful mediation helps students connect new information to their experiences and to learning in other areas, helps students discover what to do when they are Stumped, and helps them learn how to learn.

(4) Heterogeneity: In a collaborative classroom, heterogeneous groupings of students enrich learning in the classroom since the perspectives, experiences, and backgrounds of all students are important for enriching learning in the classroom. The first two characteristics capture the nature of relationships between the teacher and the students in a collaborative classroom. The third characterizes teachers' new approaches to instruction. The fourth addresses the composition of a collaborative classroom. The Smart Classroom enhances all the above characteristics of collaborative learning.

According Orr, (1997) collaborative learning is based upon the following principles:

1. Working together results in a greater understanding than what would likely have occurred if one had worked independently.
2. Spoken and written interactions contribute to this increased understanding.
3. Opportunity exists to become aware, through classroom experiences, of relationships between social interactions and increased understanding.
4. Some elements of this increased understanding are idiosyncratic and unpredictable.
5. Participation is voluntary and must be freely entered into.

The idea behind collaborative learning is that there is mutual benefit so that all group members gain from each other's efforts, recognizing that all group members share a common fate, feeling and sharing of ideas and performance. Although, according to Barbara et al, (2013), Collaborative learning is an umbrella term of educational approaches which involves joint intellectual effort by students, or students and teachers together, where students will work in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Alderman (2000), stated that there are three conditions for collaborative learning, which include the following:

(a) That knowledge is created through interaction and not transferred from educator to a student.

(b) Learning is student-centred, with consideration given to the students' levels of knowledge, experience and understanding; and

(c) The educator's role is that of facilitator of learning, developer of the structure, creator of the context, and provider of the learning space so that students can take control of their own learning.

Gokhale (1995) found that collaborative learning enhances critical thinking of students. He further stated that students who participated in collaborative learning had performed significantly better on the critical-thinking test than those who studied individually. This statement is in agreement with the learning theories proposed by proponents of collaborative learning that is Vygotsky (1978), which stated that, students are capable of performing at higher intellectual levels when asked to work in collaborative situations than when asked to work individually. Collaborative learning according to Panitz (2013):

1. Promotes student-faculty of interaction and familiarity
2. Increases student retention
3. Builds self esteem in students
4. Enhances student satisfaction with the learning experience
5. Promotes a positive attitude toward the subject matter
6. Develops oral communication skills
7. Develops social interaction skills
8. Promotes positive race relations
9. Creates an environment of active, involved, exploratory learning
10. Uses a team approach to problem solving while maintaining individual accountability
11. Encourages diversity understanding

12. Encourages student responsibility for learning
13. Involves students in developing curriculum and class procedures
14. Students explore alternate problem solutions in a safe environment
15. Stimulates critical thinking and helps students clarify ideas through discussion and debate
16. Enhances self management skills
17. Fits in well with the constructivist approach
18. Establish an atmosphere of cooperation and helping school wide
19. Students develop responsibility for each other
20. Builds more positive heterogeneous relationships
21. Encourages alternate student assessment techniques
22. Fosters and develops interpersonal relationships
23. Modeling problem solving techniques by students' peers
24. Students are taught on how to criticize ideas, not people
25. Sets high expectations for students and teachers
26. Promotes higher achievement and class attendance.
27. Students stay on task more and are less disruptive
28. Greater ability of students to view situations from other perspectives (development of empathy)
29. Creates a stronger social support system
30. Creates a more positive attitude toward teachers, principals and other school personnel by students and creates a more positive attitude by teachers toward students

31. Addresses learning style differences among students
32. Promotes innovation in teaching and classroom techniques
33. Classroom anxiety is significantly reduced
34. Test anxiety is significantly reduced
35. Collaborative Learning is synergistic with writing across the curriculum
36. Collaborative Learning activities can be used to personalize large lecture classes
37. Skill building and practice can be enhanced and made less tedious through CL activities in and out of class.
38. Collaborative Learning activities promote social and academic relationships well beyond the classroom and individual course
39. Collaborative Learning processes create environments where students can practice building leadership skills.
40. Collaborative Learning increases leadership skills of female students
41. In colleges where students commute to school and do not remain on campus to participate in campus life activities, Collaborative Learning creates a community environment within the classroom.

2.5.1 Essential Characteristics of Collaborative Learning

Academic learning success for each individual and all members of the group is one feature that separates collaborative learning groups from other group tasks (Slavin 1991). It has been clearly stated by Panitz (2013), in his article entitled "Collaborative Versus Cooperative Learning- a comparison of the two concepts which will help us understand the underlying nature of interactive learning" that most of the elements of cooperative learning

may be used in collaborative situations. In order for a lesson to be collaborative, Ranjani (2013) stated these five essential elements, which include the follows:-

(1)Positive Interdependence

(2)Individual Accountability,

(3)Face-To-Face Promotive Interaction,

(4)Small Group Skills,

(5) Group Processing

(1) Positive interdependence in this element of collaborative learning, students perceive that they need each other to complete the group's task ("sink or swim together"). Teachers may structure positive interdependence by establishing mutual goals (learn and make sure all other group members learn), joint rewards (if all group members achieve the above criteria, each will receive bonus points), shared resources (one paper for each group or each member receives part of the information), and assigned roles (summarize and encourage of participation, record, time keeping etc.). While, the second element is the;

(2) Individual accountability: - Each student's performance is frequently assessed and the results are given to the group and the individual, teachers may structure individual accountability by giving an individual test to each student or randomly selecting one member of the group to give the answer. The third element of this learning strategy is the;

(3) Face to face promotive interaction:- in these items of collaborative learning, the students promote each other's learning by helping, sharing, and encouraging efforts to learn. Students explain, discuss, and teach what they know to classmates. Teachers structure the groups so that students sit knee to knee and talk through each aspect of the assignment. Also the forth element of this learning strategy as stated by Ranjani (2013) is;

(4) Small group skill: - Students must not only engage in academic learning but also social learning during collaborative tasks. It is unrealistic to expect all members of a group, at any age or in any context, to come to group tasks fully equipped with the social skills necessary for collaboration. Indeed, addressing this as part of science education would better prepare scientists, engineers, and health care professionals for the complex social dynamics of our laboratories and clinics. Given that, instructors can aid students in developing these skills by defining and expecting collaborative behaviors. Some of the skills of collaborative learning include actively listening to all members of the group, actively encouraging all members of the group to verbally participate in discussion, being critical yet supportive of alternative views, maintaining opinions until convincing contrary evidence is provided, and learning how to ask clarifying questions of others. The fifth is

(5) Group processing: - Groups need specific time to discuss how well they are achieving their goals and maintaining effective working relationships among members. Teachers structure group processing by assigning such tasks as:

(a) List at least three member actions which helped the group to be successful and

(b) List one action that could be added to make the group more successful tomorrow. Teachers also monitor the groups and give feedback on how well the groups are working together and the class as a whole.

Stahl (1994), stated fourteen elements of collaborative learning, which includes the following:

1. A clear set of specific student learning outcome objectives
2. All students in the group “buy into” the targeted outcome
3. Clear and complete set of task-completion direction or instructions

4. Heterogeneous group

5. Equal opportunity for success

6. Positive interdependence

7. Face-to-face interaction

8. Positive social interaction behaviors and attitudes

9. Access to must learn information

10. Opportunities to complete required information-processing tasks

11. Sufficient time is spent during learning

12. Individual accountability

13. Public recognition and rewards for group academic success

14. Post-group reflection (or debriefing) on within group behaviors

In collaborative learning groups, teachers need to begin planning by describing precisely what students are expected to learn and be able to do on their own will, beyond the end of the group task and curriculum unit. Regardless of whether these outcomes emphasize academic content, cognitive processing abilities, or skills, teachers should describe in unambiguous language the specific knowledge and abilities students are to acquire and then demonstrate on their own. Although, in the second element, it is not sufficient for teachers to select outcome objectives: students must perceive these objectives as their own. They must come to comprehend and accept that everyone in the group needs to master the common set of information and/or skills. In selected strategies where groups select their own objectives, members of each group must accept their academic outcome they all must achieve.

However, in the third element of collaborative learning, teachers need to state directions or instructions that describe in clear, precise terms exactly what students are to do, in what order, with what materials, and, when appropriate, what students are to generate as evidence of their mastery of targeted content and skills. These directions are given to students before they engage in their group learning efforts. In the fourth element, teachers should organize the three-, four-, or five-member groups so that students are mixed as heterogeneously as possible, first according to academic abilities, and then on the basis of ethnic backgrounds, race, and gender. Students should not be allowed to form their groups based on friendship or cliques. When groups are maximally heterogeneous and the other essential elements are met, students tend to interact and achieve in ways and at levels that are rarely found in other instructional strategies. They also tend to become tolerant of diverse viewpoints, to consider others' thoughts and feelings in depth, and seek more support and clarification of others' positions.

However, in the fifth element every student must believe that he or she has an equal chance of learning the content and abilities, and earning the group rewards for academic success, regardless of the group he or she is in. In other words, the student must not feel penalized academically by being placed in a particular group.

In addition, in sixth element teachers must structure learning tasks so that students come to believe that they sink or swim together--that is, their access to rewards is as a member of an academic team wherein all members receive a reward or no member does. Essentially, tasks are structured so that students must depend upon one another for their personal, teammates', and group's success in completing the assigned tasks and mastering the targeted content and skills.

Also in the seventh element Students need to arrange themselves so that they are positioned and postured to face each other for direct eye-to-eye contact and face-to-face academic conversations. The eighth element of collaborative learning explain that, because students are placed in a groups and expected to use appropriate social and group skills does not mean students will automatically use these skills. To work together as a group, students need to engage in such interactive abilities as leadership, trust-building, conflict-management, constructive criticism, encouragement, compromise, negotiation, and clarifying. Teachers may need to describe the expected social interaction behaviors and attitudes of students and to assign particular students specific roles to ensure that they consciously work on these behaviors in their groups.

In the ninth element of collaborative learning, teachers must structure the tasks so that students have access to and comprehend the specific information that they must learn. The content focus of learning tasks must be aligned directly with the specific outcome objectives and the test items that will be used to measure their academic achievement. the tenth element stated that, for students to be successful, each must complete a number of internal information-processing tasks aligned with targeted objectives, such as comprehending, translating, making connections, assigning meanings, organizing the data, and assessing the relevancy and uses of the information they study. Assigned group tasks direct students to complete the relevant internal processing tasks they need to complete.

Nevertheless, in the eleventh element each student and group should be provided with amount of time needed to learn the targeted information and abilities to the extent expected. Without students' spending sufficient time learning, the academic benefits of cooperative learning will be limited (Stahl 1994). Many of the positive affective, social

skills and attitudes, and academic benefits of cooperative learning tend to emerge and be retained only after students have spent four or more weeks together in the same heterogeneous group.

In the twelve element, teachers should give reasons why they categorize students in this group's work, for all students to achieve higher academic success individually than to study alone. Consequently, each must be held individually responsible and accountable for doing his or her own share of the work and for learning what has been targeted. Therefore, each student must be formally and individually tested to determine the extent to which he or she has mastered and retained the targeted academic content and abilities.

In thirteen elements of collaborative learning, only members of groups who meet or surpass high levels of academic performance receive ample rewards within formal public settings. The specific awards must be something valued by the students. In the fourteen element students spend time after the group tasks have been completed to systematically reflect upon how they worked together as a team in such areas as:

(a) How well they achieved their group goals,

(b) How they helped each other comprehend the content, resources, and task procedures,

(c) How they used positive behaviors and attitudes to enable each individual and the entire group to be successful, and

(d) What they need to do next time to make their groups even more successful.

Every one of the preceding elements does not have to be used every time the teacher assigns students to work in groups. However, teachers who fail to include these requirements report far more difficulties with their students and their group activities, and far less student academic achievement gains than the teachers who meet them. As a general

rule, unless a well-researched strategy is used that allows for an alternative to one or more of these elements, teachers serious about implementing effective collaborative learning activities need to ensure that these requirements are met for each collaborative learning strategy they use, otherwise they are using structured collaborative groups. More importantly, unless these elements are used frequently and correctly, teachers should not expect the many positive long-term results of this learning package that can be achieved.

Collaborative learning has certain common questions to be asked, as stated by Diana et-al (2007); these questions are:

a. How do I decide which assignments/activities to make collaborative?
b. How do I divide students in to groups?
c. How can I help students to work in groups?
d. How can I deal with conflicts within the groups?
e. How can I grade collaborative work?

2.5.2 Models of Collaborative Learning Strategy

Collaborative learning has several activities, which help to improve students' learning. These activities can be classified into several models. The widely used techniques or models of collaborative learning strategies as stated by Ford (2013) and Panitz (2013) include:

1. Think-Pair-Share
2. Jigsaw
3. Buzz Groups.
4. Standard Teams-Achievement-Divisions
5. Critical Debates

6. Johnson and Johnson model

1. Think, Pair, and Share: - This strategy encourages students to participate individually with specific responsibilities and collaboratively as they share ideas back with the larger group. There are three distinct steps in the Think, Pair, and Share strategy, this include the following;

Think – students are asked to think independently about the question that has been posed, thus forming independent ideas.

Pair – students are grouped with a partner to discuss their ideas and thoughts. This step is critical as it allows students an opportunity to articulate their own ideas as well as consider the ideas of their partner.

Share – student pairs then share their ideas on the question or topic with the larger group or whole class. This process allows students to clarify their ideas individually, then within a small group before having to present in front of a larger audience.

2. Jigsaw is a method intended to provide collaborative learning environments. Its development began in the 70s by E. Aronson at University of Texas and University of California. Jigsaw is a face-to-face method, without technological support. It emphasizes interaction among workgroup members. This collaborative learning strategy is appropriate for all levels of students and works well with large or small classes. This strategy encourages and reinforces a variety of skills such as listening, engagement and empathy by establishing an interdependent group where members have both individual and group responsibilities. This strategy also facilitates interaction among all students in the class as they work to accomplish a common goal. It also requires a higher level of

understanding of particular topics, since each student will be required to "teach" their group members what they learned. There are three distinct steps in the Jigsaw strategy.

1. Establish "Home" groups. Divide the material to be covered into approximately four to five topics. The home group will consist of the same number of students as you have topics. Each member of the home group will then be assigned to an expert or research group based on your content topics.

2. Assign topic exploration activities so that each member of the expert group will accurately and thoroughly understand the material assigned to their expert group.

3. Once the expert groups have a solid understanding of their topic material, they will return to their home group to teach that information to other members of home group. Success depends on the determination that all group members understood the required topical concepts.

4. Buzz Groups. This collaborative learning strategy is appropriate for most grade levels but is particularly appropriate for college-age students and can easily be adapted for both large and small classes. This strategy requires brainstorm ideas as fast as possible within a small group. This encourages critical thinking, but also adds the urgency of time which can be competitively motivating for some students. There are three distinct steps in the Buzz Group strategy.

1. Allow students to self-select into small groups of three to five members. Each group should assign one person to serve as the recorder of the ideas generated.

2. Each small group will share some of the ideas with the whole group, allowing each group to contribute to the conversation.

3. Once all groups have presented, any group can present additional ideas that were not previously presented.

4. Standard Teams-Achievement-Divisions **(**STAD). This is developed by Slavin in the year 1978 and is considered one of the basic approaches of introducing learners to collaborative learning. The use of this method is thought as an effective and efficient way to teach well-defined educational subjects. The teams are heterogeneous, made up of learners of diverse academic performance, race, and nationality. The rewarding of the best teams motivates the better students in a team to encourage other members to achieve their mutual goal.

The main Goals of this model are to motivate students to encourage and help each other, and to accelerate student performance. The model also helps to facilitate gains in self-esteem, liking of class, which improve the behavior of the learners.

5. Critical Debates. This collaborative learning strategy is appropriate for most grade levels but is particularly appropriate for college-age students and can easily be adapted for both large and small classes.

This strategy requires students to engage in critical thinking as they research the positives and negatives of a particular topic and reinforces the articulate communication in views of the side for which they are assigned to argue. This strategy also encourages positive competition which can be very engaging for some students. There are four distinct steps in the Critical Debate strategy.

1. Assign debate groups. Groups may be as small as two or up to four maximum participation values. Assign which side of a topic each debate group will argue.

2. Students in each debate group will explore their topic and identify their strongest points to present their view.

3. Members of the debate group will have three to five minutes to present their best arguments to the opposing group. Then the opposing group will have three to five minutes to present their best arguments.

4. After initial arguments are heard, each group will discuss how to counter the points presented by the opposing group. Then each group will have two minutes to present their points. At the end of that time, remaining members of the class can determine which group had the most convincing arguments on the topic.

5. Johnson and Johnson's Model (1975):- Johnson and Johnson Model is another instruction that involves students working in teams to accomplish a common goal. Under the conditions which involves students working in teams to accomplish a common goal, under the following elements, which include positive interdependence, individual accountability, face to face promotive interaction, appropriate use of collaborative skills and grouping processing. In this model, members of the class are grouped into four or five members.

In this Group work, a common assignment is given to group and submit a group report of their results. Class work was based on the group work. Apart from assigning the group tasks, the teacher's role was to provide group relationship and encouragement between members of the groups. Johnson and Johnson (1975) proposed that learning exercise and qualities of this learning strategy have a relationship with the five elements earlier mentioned. This model of Johnson and Johnson is more effective at providing meaningful learning than competition or individualization. Therefore, in this study, the

Johnson (1975) model was adopted, because Panitz (2013), stated that model of cooperative learning are also used in collaborative learning. In addition, this learning strategy involves students working in teams to accomplish a common goal, under the conditions, which involves students working in teams to accomplish common goals.

2.5.3 Similarities between Collaborative and Cooperative Learning

According to Ford (2013), Collaborative learning requires working together toward a common goal. He further stated that this type of learning has been called by various names; cooperative learning, collaborative learning, collective learning, learning communities, peer teaching, peer learning, or team learning. What they have in common is that they all incorporate group work. However, collaboration is more than co-operation. Collaboration entails the whole process of learning. This may include students teaching one another, students teaching the teacher, and of course the teacher teaching the students, too. More importantly, it means that students are responsible for one another's learning as well as their own and that reaching the goal implies that students help each other to understand and learn. The basis of both collaborative and cooperative is constructivism: knowledge is constructed, and transformed by students.

The learning process must be understood as something a learner does by activating already existent cognitive structures or by constructing new cognitive structures that accommodate new input. Learners do not passively receive knowledge from the teacher; teaching becomes a transaction between all the stakeholders in the learning process. Johnson and Johnson and Smith (1991), defined these terms: collaborative and cooperative. Collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and

contributions of their peers, and also collaboration is a structure of interaction designed to facilitate and accomplishment of a specific end product or goal through people working together in groups. While on the other hand, cooperative learning is a process means to facilitate the accomplishment of a specific end product or goal through people working together in groups. Inevitably, cooperation and collaboration seem to overlap, but in the cooperative model of learning, the teacher still controls most of what is going on in the class, even if the students are working in groups, while collaborative learning, on the other hand, aimed at getting the students to take almost full responsibility for working together, building knowledge together, changing and evolving together and of course, improving together.

Panitz (2013), stated that models of cooperative learning are also used in collaborative learning where in collaborative learning groups would assume almost total responsibility for answering the question. The students determine if they had enough information to answer the question. If not, they identify other sources, such as journals, books, videos, the internet, to name a few. The group members would decide how many reasons they could identify which would distribute the work of obtaining the extra source materials among the group members. The collaborative teacher would not specify a number, but would assess the process of each group and provide suggestions about each group's approach and the data generated. It might also occur to the students to list the reasons in order of priority. The teacher would be available for consultations and would facilitate the process by asking for frequent process reports from the groups, facilitate group discussions about group dynamics, help with conflict resolution, etc. The final product is determined by each group after consultation with the teacher. Each group would

also negotiate the means of assessment of the group's performance with the teacher. As stated above, Panitz (2013), says that many of the elements of cooperative learning may also be used in collaborative situations. For example, students work in think-pair-share procedure, where students consider a question individually, discuss their ideas with other students to form a consensus answer, and then share their results with the entire class. The use of pair can be introduced at any time during a class to address questions or solve problems or to create variety in a class presentation.

The jigsaw method is a good example, whereby the students become "expert" on the concept and they are responsible for teaching it to other group members. Group subdivides a topic and members work together with those from other groups who have the same topic. They then return to their original groups and explain their topic.

Student Teams- Achievement- Divisions is another collaborative learning strategy, which is developed by Slavin in the year 1978, where the teacher presents a lesson, and then the students meet in teams of four or five members to complete a set of worksheets on the lesson. Each student then takes a quiz on the materials and the scores the students contribute to their teams are based upon the degree to which they have improved their individual past averages. The highest scoring teams are recognized in a weekly class newsletter. Therefore, this study would be conducted using collaborative learning strategy, because it has root with the constructivism where students can actively construct their knowledge based on the little knowledge the learner has to see if these learning strategies would help low ability basic science students to overcome their problems in learning science at junior secondary school level.

2.5.4 Collaborative Learning and Academic Achievement

A number of researches on collaborative learning have been carried out in the world. These studies have shown that collaborative learning lead to improve students' learning and revitalized teaching methods (Skon, Johnson, Johnson 1981; Cused 1990; Slavin 1991; and Johnson Johnson 2000). Another benefit identified by researches includes higher academic achievement and when students of different racial or ethnic backgrounds work together towards a common goal, liking and respect for one another is increased (Slavin, 1991). Johnson and Johnson (1998), stated that working together with peers and valuing would result in greater psychological health that does competing with peer or working independently.

Gokhale (1995) conducted a study titled "Collaborative Learning Enhances Critical Thinking" and found that students critical thinking skills improve positively in collaborative learning environment than those working individually. This is in accordance with the opinion of Vygotsky (1978), which says that the intellectual students will perform higher in collaborative situations than individual. Jantii (2002), found that when students work together in a complex task, they help each other, resulting in a focused dialogue, and can solve a difficult problem, which cannot be done individually. Tudge (1992) suggests that collaboration has strong impact on student performance, and change the reasoning ability of the students. Collaborative learning is believed to prepare students for modern participative workplace (Feichter & Davis 1991). Lakkala (2007), further pointed out that students are active agents who share ideas, solve problems, use various information sources and create knowledge together.

However, recent studies have indicated that there are other factors that can be useful predictors of academic performance which one of the factors is personality (Busato, Prins, Elshout, and Hamaker,, 2000; Chamorro-Premuzic and Furnham, 2003). According to Colman (2006) in Mariam and Alias (2012), personality is the sum total of the behavior and mental characteristics that are distinctive of an individual. Personality is also described as a categorized set of attributes that is found in a person that influences and defines the individual's cognition, motivations and behaviors. Larsen and Buss (2008) in Mariam et-al (2012) defined personality as a set of psychological traits and mechanisms within an individual that are organized and relatively enduring and that influence his/her interactions with, and adaptations to the environment". However, based on the above studies, which show that collaborative learning enhanced the students' academic achievement, this study would be conducted using low ability Basic Science students to see if this learning strategy would help low ability Basic Science students to overcome their problems academically.

2.6 Concept of Low Ability

Low-achieving students were often chronically engaged in lower order cognitive assignments because they never mastered the simplest level of knowledge, in contrast, higher achieving students, having mastered the basic skills, were viewed as prepared to handle more complex learning tasks (Shepard, 1991). Herrstein and Murray (1994), Dickens (2005), and Lathan (2006) categorized students in two-category ability as "low cognitive ability and high cognitive ability". According to them, student whose score falls below 40% in a given standardized test of cognitive ability and such student may not be expected to achieve mastery or recall stored information (schemata) within a reasonable amount of time, such a student is said to have low cognitive ability, where a student scores

40% and above in a given standardized test of cognitive ability; indicates that the student can achieve mastery and can recall stored information (schemata) within a stipulated amount of time, such a student is said to have high cognitive ability. Also Ajewole and Okebukola (1997) in Lakpini (2012) stated that students are categorized into three categories, which include “High ability students, then Average ability students and finally the Low ability students”. In identifying low ability students, a website called ‘Helping slow learners’ (www.foundationosa.org/slow.htm) listed ten characteristics of low ability learners:

1. Functions at ability but significantly below grade level.
2. Is prone to immature interpersonal relationships.
3. Has difficulty following multi-step directions.
4. Lives in the present and does not have long range goals.
5. Has few internal strategies (i.e. organizational skills, difficulty transferring, and generalizing information).
6. Scores consistently low on achievement tests.
7. Works well with "hands-on" material (i.e. labs, manipulative, activities.)
8. Has a poor self-image.
9. Works on all tasks slowly.
10. Masters skills slowly; some skills may not be mastered at all.

2.6.1 Motivating Low Ability Learners

Motivation is a factor of supporting a person's success in learning anything. Motivation refers to the incentive or energy that drives an individual to take an action (Reeve, 2005).Internal motivation has a very important role than external motivation,

although both are mutually supportive. Motivation itself is a kind of encouragement of someone who was able to move, as Harmer (2001) stated, "motivation is some kind of internal drive which pushes someone to do things in order to achieve something". In addition, motivation can be defined as a push or a strong desire for something that one decides to do something to achieve his desire. Therefore, motivation is absolutely necessary in the learning process in the classroom. Motivation of both teachers and students are able to create a synergy learning success in the classroom. Harmer (2001) stated that there are several sources of motivation, which can be acquired by students which include the following;

1. Social environment in which people lived, that is the environment outside of the classroom.
2. Another thing that is significant to the students' life, for example, is the influence of other cultures and the world around the students' life.
3. Teacher is the main factor of continuity in students' motivation to learn.
4. Method of teaching, is a vital factor for the success of the learning process.

However, teachers need to find ways in motivating students to learn. There are various ways, in which a teacher can enhance students' motivation. Harmer (2001), describes three ways to increase students' motivation.

1. Setting goals and objectives. The goals are classified into short-term and long term goals.
2. Learning environment. Creating a fun learning environment, this includes physical condition of the classroom and emotional atmosphere of the teachers.
3. Interesting classroom activities. Topics and classroom activities should be interesting.

Harmer (2001) suggests that students learn more quickly if the teaching methods used match their preferred learning styles. This has a further positive effect on learning; students who have become bored with learning may become interested once again. The student-teacher relationship can improve learning, because the student is more involved which makes learning successful and more interesting. A number of strategies are suggested in the literature for supporting and motivating low ability learners. Lescano (1995), for example, suggests the following:

• Give daily evaluations.

• Use simple vocabulary in directions and instructions.

• Use standard formats and limited types of responses for each assignment.

• Provide multi-sensory prompts to elicit correct responses.

• Analyze and break down difficult tasks.

• Increase time-on-task rates (more teacher questions, group participation, effective use of signals, gestures, etc.).

• Reduce distractions by providing a quiet, private place to work.

• Emphasize strengths. Use lots of praise and reinforcement frequently.

• Make lessons short. Limit the working time and have several short work periods rather than one long one.

• Add variety to the academic routine. Do active things and use educational games, puzzles, and other techniques as much as possible.

• Work on material that is somewhat challenging but allows success. Work that is too hard or too easy is a turn-off.

• Make learning fun and comfortable. Your positive attitude is very important.

• Communicate with your students.

• Go over his/her daily work to reinforce the learning. Slower learners need repetition.

• Provide meaningful, concrete activities rather than abstract.

• Give short specific directions and have your child repeat them back to you.

• Encourage your child to explore areas of interest to him/her. Career opportunities often come from these interests.

Barbara (1999) stated that to encourage students to become self-motivated and independent learner, teacher should consider the following;

1. Give frequent, early and positive feedback that support students beliefs that they can do well.

2. Ensure opportunities for student's success by assigning tasks that are neither too easy nor too difficult.

3. Help students to find personal meaning and value in the material.

4. Create an atmosphere that is open and positive.

5. Help students to feel that they are valued members of the learning community. Since collaborative learning strategy involves students to work in small groups, therefore these would motivate low ability students to achieve academically, because collaborative learning strategy involves students to work in small group.

2.7 Relationship between Collaborative Learning Strategy and Achievement among Students of Varied Abilities

This is another area of discussion by some researchers in the area of collaborative learning. Bani (2012) found in a research that the academic performance of low ability students increased as a result of coached by high ability students in collaborative groups while the act of being coaching helps the higher ability students to internalize the content

much better. In support, this statement, Mariam et-al (2012), stated that excellence in academic life demands high level of intelligence.

Study on group composition and learning generally shows that when students of varied abilities actively participate in group collaboration, low ability students learn best in groups with high ability students, high ability students perform well in group composition, and medium-ability students learn most in relatively homogeneous groups as stated by Lou et-al (1996).

Similarly, for medium-ability students, study conducted by Webb (1991) shows that they learn less in heterogeneous groups than in homogeneous groups. Possible causes for this may be excluded from the teacher/ learner relationships that develop between high and lows; they may not be allowed to actively participate. A survey also shows that learning in collaborative groups could be beneficial to high, medium and low ability students (Cohen, 1994). Meanwhile, in other direction O'Donnel and Dansereau (1992), found that students in heterogeneous ability have high academic achievement than students who learn in homogeneous ability. Collaborative learning usually involves heterogeneous group, that is, groups are formed by combining students of disparate ability, gender, or ethnic background (Hooper, 1992; Johnson and Johnson, 1993). However, there is a considerable disagreement regarding the effects of heterogeneous group on the performance and attitudes of students representing different abilities. Advocates of heterogeneous group claimed that there might be great advantages to having students with different abilities work together on collaborative tasks. They argued that while high ability students benefit from providing explanations to partners, low-ability students benefit from the increased opportunities for support and encouragement.

Bandura (1977), also suggests that low-ability students may learn Meta cognitive skills more effectively in groups through model than when learning alone. The results of some experimental studies show that students of all abilities benefit from participating in a heterogeneous collaborative groups compared to students of similar ability who worked alone (Dalton et al., 1989; Johnson and Johnson, 1993; Johnson et al., 1991; Simsek and Tsai, 1992). Therefore, some critics claim that heterogeneous group promotes personal gains at the expense of others. For example, Dalton (1990), found that heterogeneous group benefited the most, but did little for the least able students. In addition, Hooper and Hannafin (1988) found that low-ability students demonstrated higher performance in heterogeneous groups, but high-ability students performed better when grouped homogeneously. Webb (1982) reported that average students in homogeneous groups showed higher performance and received more explanations than average students in heterogeneous groups. We can thus infer from the aforesaid that there is a clear relationship between the collaborative learning strategy and academic achievement of varied ability students.

The literature reviewed shows that low ability students benefit more when mixed in a collaborative learning group with high ability students. In addition, homogenous ability group helps in motivating low ability students, because Adodo and Agbayewa (2001) conducted a study on the effect of homogenous and heterogeneous ability grouping class teaching on students' interest, attitude and achievement in integrated science and found that homogenous ability grouping is superior for promoting academic performance of low ability students. Therefore, this study would be conducted using homogenous Basic

Science students in order to find out if collaborative learning strategy would help this homogenous ability group in learning.

2.8 Gender Differences and Performance in Science

Gender in common usage refers to the sexual distribution between male and female, while the Social scientists however refer to the term as a social construction rather than a biological phenomenon (Leonard, Benjamin and Sagary, 2011). The relationship between gender and the academic achievement of students has been discussed for decades (Eitle, 2005). A gap between the achievement of boys and girls has been found, with girls showing better performance than boys in certain instances (Chambers and Schreiber, 2004).

Gender, ethnicity, and father's occupation are significant contributors to students performance (McCoy, 2005; Peng and Hall, 1995). Fisho-Oridedi (2001) in her book *The Girl Child* noted that "the Nigerian population in 1991 was 88,514,501. The population of men (male) is 44,544,053 which is 50.32% while that of women (female) is 43,969.970 which is 49.7% of the total population". The above data indicated that women constitute almost half of Nigerian population and their potentialities in contributing to the national development cannot be over-emphasized.

Ibraheem (2001), confirmed the above statement that "women constitute about 50% of Nigerian population and their potentiality in contributing to the national development cannot be ignored". What has remained the main focus of great concern in the field of science education are the biases and misconceptions about women and science, i.e. Science is a male enterprise (Erinosho, 2005). Many researches have been carried out on gender

issues in science education (Bilesanmi-Awoderu, 2002; Erinosho, 1997; Erinosho, 2005; Kennedy, 2000, etc.).

Many researchers provided reports that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students with respect to gender. Many scholars (Arigbabu and Mji 2004; Bilesanmi-Awoderu, 2006; David and Stanley, 2000; Hyde and McKinley, 1997; Kolawole, 2007), found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. There is a strong association between gender and response to science education. The likely influence of gender factors on students' academic achievement in basic science when taught using the collaborative learning and conventional methods will be examined by this study.

Chin-chau (1997), investigated on the effect of classroom goal structures on children's goal orientation, mathematics achievement and intrinsic motivation. He also assessed gender effects, and the interaction effects between goal structure and gender in these learning situations on the variables related to mathematics learning. The results showed no significant gender effects on the variables of goal orientation, mathematics achievement, intrinsic motivation, and beliefs about failure. Drzewiecki and Westberg (1997) carried out a survey on high school students to better understand how students' attitudes toward mathematics differ by gender and by grouping technique used for mathematics instruction. More specifically, the survey examined the impact of cooperative grouping as an alternative to traditional mathematics instruction for improving females' attitude toward mathematics, analysis of variance indicated that there were no significant main effect for gender and instructional methods.

Ogunkola and Bilesanmi-Awoderu (2000) carried out a research on the effectiveness of laboratory-based and lecture methods on students' achievement in Biology; the result of the study shows that students' performance in Biology was not sensitive to the sex of students. Bilesanmi-Awoderu (2002) carried out a study on the concept mapping, among Nigerian high school students' achievement in Biology, found that there was no significant main effect of gender on students' achievement in Biology.

However, on heterogeneous ability grouping, Mari and Tongding (2010) carried out a research on comparisons of academic performance of biology students. The result of the study shows that male and female students do not differ significantly in performance. Viann (2004) investigated differences and the effects of cooperative learning in mathematics classroom setting, using cooperative learning strategy based on the learning together model of Johnson and Johnson (1991). The results revealed that no significant gender-related differences, but females achieved slightly higher grades than males.

In addition, Pandian (2004), investigated the effects of cooperative computer-assisted learning method on male and female students' achievement in biology; the students were randomly grouped into cooperative computer assisted learning and traditional method groups. The analysis of results indicated that gender did not express any significant influence on biology performance. However, male and female students in the cooperative computer-assisted instruction group showed remarkable differences over their respective counterparts who learned the same biology concepts through traditional method.

Samuel and John (2004) examined how the cooperative class experiment teaching methods affect students' achievement in Chemistry. The result shows that the girls taught through cooperative class experiment method performed better than girls taught through

the conventional teaching method and the researchers also pointed out that there was no significant difference in achievement between boys and girls exposed to cooperative class experiment method, both performed significantly better than those taught through conventional lecture method.

Also, Oludipe Daniel (2012), conducted a study on gender difference in Nigerian junior secondary students' academic achievement in Basic Science. He found that female students perform slightly better than the male students. In their own study, Jegede and Inyang (1990) worked on gender differences and academic achievement in integrated science in Junior Secondary Schools. They confirmed that males performed better than females. They affirmed that males demonstrated significantly more positive attitudes towards science than females. Owuamanam and Babatunde (2007) noted that the girls tend to go for courses that do not require more energy and brain tasking such as home making while boys looked for jobs in management, engineering, banking and other brain-tasking professions.

However, in another research conducted by Joel and Sesugh (2006) on gender differences and achievement in calculating reacting masses from chemical equations among secondary school students in Makurdi Metropolis. The results have shown that boys perform better than girls in chemistry problem solving which requires the use of mathematics.

2.9 Over view of Similar Studies on Collaborative Learning Strategy

A lot of studies were carried out at many places in different times in relation to this study, among which are Chianson, Kurumeh, and Obida, (2010) where they studied the effect of cooperative learning method compared with the conventional learning method in

order to find out the retention level of students' in circle geometry. The study was on senior secondary II students in the three educational zones (Zone A, Zone B and Zone C) in Benue State, Nigeria. The ability of students to grasp and memorize a mathematical concept or topic that was taught has become a basic problem in secondary schools. These problems may arise due to inappropriate teaching methods being used to explain these topics. Hence, this study adopted the cooperative learning strategy to teach 358 senior secondary two (SSII) students circle geometry, and see how well the learning method may effectively improve on students' ability to retain concepts in mathematics in comparison to the conventional learning method of teaching. An independent t-test analysis was used to determine whether a statistical significant difference existed between the cooperative learning approach and the conventional learning approach in terms of students' retention of the taught concept ($t(356)= 8.474$, $p= 0.001$).

The findings of the study confirmed that students who were subjected to the cooperative learning strategy were able to retain the concepts of circle geometry more than those taught using the conventional learning approach. Hence, the recommendations were that, students would be able to retain, taught and learnt concepts in mathematics for a longer period of time if mathematics teachers applied the cooperative learning strategy in teaching.

Gomez, Nussbaum, Weitz, Lopez, Mena, and Torres, (2013) investigated the effect of Co-Located Single Display Collaborative Learning for Early Childhood Education, in Chile Metropolitan Region. The study was implemented in 10 kindergarten classrooms with 268 children between the ages of five and six years old. A group of five kindergarten classrooms with equivalent characteristics participated as comparison group. During the

four month intervention children worked in collaborative activities at least twice a week. A quasi – experimental approach was used to assess the implementation including pre and post testing. Differences in learning of oral language, logic-mathematic and social skills were found, with significant better achievements in the experimental group.

In another study conducted by Cirila Peklaj (2003), in Slovenia to investigate the effects of cooperative learning on achievement in mathematics and native language and to analyze students' achievement in cooperative learning according to their gender, abilities and cognitive style. Three hundred and seventy three (373 in the experimental and 203 in the control group) fifth grade students from nine different primary schools participated in the study. In experimental group, collaborative learning was introduce in one quarter of the hours dedicated in mathematics and Slovene Language during the school year. Control group received the traditional way of teaching in both courses. The results were analyzed with ANOVA. Positive effects of collaborative learning were found in both courses. Results in collaborative learning group were further analyzed according to students' gender, abilities and cognitive style. No significant interaction between students achievement and their gender or abilities were found. Statistically, significant interactions between students cognitive style achievement were found in both courses. Field-dependent students benefit most from collaborative learning.

In addition, Patrick and Ochuko (2010), conducted study in Benin City of Nigeria to determine how the adoption of cooperative learning as an instructional strategy for teaching Integrated Science influences students' achievement and attitude towards studies. The study also determined how moderating variables like sex and ability affect students'

achievement in Integrated Science when cooperative learning is used as an instructional strategy.

To guide this study, five hypotheses were stated and tested at 0.05 level of significance. The design of the study was a 2x2x2x2 factorial, pre-test, post-test control group design. These included two instructional groups (cooperative and traditional classroom groups), sex (male and female), ability (high and low), and repeated testing (pre-test and post-test). The population of study was made up of 205 JS III students from where a sample of 120 students were randomly selected. The instruments used for the collection of data included: a Scholastic Ability Test in Integrated Science (SATIS), Students' Attitude Scale (SAS), and Integrated Science Achievement Test (ISAT). All the data collected were analyzed with analysis of co-variance statistic.

The major findings of the study included; a significant higher achievement test scores of students in cooperative learning group than those in traditional classroom; a significant higher attitude scores of students in cooperative learning group than those in traditional classroom; a significant higher achievement test scores of all students of varying abilities in cooperative learning group than those in traditional classroom; a non-significant difference in achievement test scores between the male and female students in the cooperative learning group, and non significant interaction effect between sex and ability, sex and method, ability and method and among method, sex and ability on achievement.

Joseph, Kate and Peter (2009) conducted study to investigate the effects of mediated learning experience, tutor support and peer collaborative learning on academic achievement and intellectual functioning. The sample comprised 111 first year engineering

students (males=38, females=73, age range =16-23), who were randomly assigned to three learning conditions (Mediation: n=45, Tutor: n=36 and Peer: n=30). Data on academic achievement were based on mid-year and end-year examination results. While, intellectual functioning was measured by the Ravens Advanced Progressive Matrices and the Organizer. Paired t-tests and Analysis of Covariances (ANCOVAs) were conducted to compare pre- and post- test academic and intellectual scores and comparison between the groups. Following a five-week intervention period, significant improvements in academic and intellectual functioning found within the Mediation Group.

The findings revealed that intervention involving mediation processes was more effective in enhancing students' intellectual not only functioning but also improving their academic achievements.

Also Lakpini (2012), conducted study to investigate the effect of a conceptual change instructional strategy on the achievement, retention and attitude of secondary school biology students with varied abilities using the Powerful Ideas in Physical Science: The conceptual change instructional strategy on the academic performance of biology students of average and low abilities when compared with their counterparts of high and average abilities taught using traditional talk and chalk model. The research design was the experimental/control matched group design using Pretest to ensure equivalence and posttest to generate data used for analysis in this study. The results obtained from analysis of data showed that;

(i) there was no significant difference in the performance of average ability subjects taught using Conceptual Change Instructional Strategy and high ability group subjects taught using traditional method.

(ii) Low ability subjects exposed to conceptual change strategy performed significantly better than average ability subjects taught using traditional method.

(iii) Subjects of low ability exposed to conceptual change strategy performed significantly better than low ability subjects exposed to traditional method.

Based on these findings, a number of recommendations were made among which is the need for the provision of instructional materials to facilitate the use of the strategy. Therefore, based on the above studies, the researcher would investigate the effects of collaborative learning strategy on academic performance among the junior secondary school two low ability students using basic science subject.

2.10 Implications of the Literature Reviewed on the Present Study

The literatures review start by defining the terms: science and basic science philosophy, and the objectives of basic science were reviewed. In the present days, teachers used traditional lecture method when teaching science in schools, which is inappropriate and are discouraged by the researchers in education. In addition, different science teaching methods used by the science teachers which include lecture, discussion, demonstration, laboratory/experimental, field trip, assignment, play-way, peer teaching and role playing methods were reviewed. The advantage and disadvantage of lecture method were also reviewed. The review described that collaborative learning strategy improves academic performances of the students as well as their critical thinking ability. Collaborative learning strategy has certain characteristics which help in the teaching and learning using collaborative learning strategy, this was discussed in the literature review.

Moreover, the literature discussed the ways teachers, educationists; parents and other stakeholders on education can categorize students of different ability levels, and the ways of helping low ability students with peculiar problems in learning and require special assistance were reviewed. The importance of collaborative learning is not to only improve critical thinking but also to make students obtain self-expression, self-motivation, leadership characters, and the increase of academic performances. The relationship between collaborative learning and academic performance of students with low ability cited shows that collaborative learning increase academic performance of the students.

In relation to gender in science education, the relationship between gender and the academic performance of students is a continuous process and some related literatures were studied. While the literature on collaborative learning using low ability basic science students was scanty, this is what motivated the researcher to think and conduct this study on collaborative learning strategy to help those low ability students and all stakeholders in the education sector.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study investigated the effects of collaborative learning strategy on performance in Basic Science among Junior Secondary School Two (JSS II) students of low ability in Fagge Local Education Authority of Kano State. The methodology employed for the study is presented in this chapter under the following sub-headings.

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

3.2 Research Design

The research design for this study is quasi experimental pretest posttest control group design. A pretest was administered to determine the equivalence in ability level of these two groups (experimental and control groups). Treatments were administered to the

experimental groups by exposing the study subjects to collaborative learning strategy, while the control group was taught using convectional lecture method. At the end of the six-week treatment periods, the posttest was administered to both experimental and control groups. Basic Science Achievement Test (BSAT) was used in both the pretest and posttest. The scores from the performances of both experimental and control groups were collected and analyzed in order to determine the differences in the students' performance using the SPSS statistical package. The design of the study is presented as shown in Figure 3.1.

$$EG \rightarrow O_1 \rightarrow \quad X_1 \rightarrow O_2$$

$$CG \rightarrow O_1 \rightarrow \quad X_O \rightarrow O_2$$

Figure 3.1: Research Design Illustration

Where;

EG = Experimental Group

CG= Control Group

O_1 = Pretest

O_2 = Posttest

X_O = No Treatment

X_1 = Treatment

3.3 Population of the Study

The population for this study comprised all the second year students in Junior Secondary School (JSS II) Students in Fagge Local Education Authority, Kano State, Nigeria. The researcher selected Fagge Local Education Authority, because it is among the seven local education authorities in Kano metropolis and is among the local education areas with the highest number of schools and students. In this local education authority,

there are twenty-five secondary schools with a population of six thousand seven hundred and fifteen students (6,715) made up of 2,649 girls and 4,061 boys. The record of enrolment of all the students in this target population and the summary of the population of this study is presented in Table 3.1.

Table 3.1 Population of the Study.

Name of school	School type	Number of male	Number of female	Total
ADSS Bukavu	Boys	540	-	540
GASS Kwachiri	Boys	360	-	360
GC Kano KTC	Boys	460	-	460
GJSS Dabo	Boys	180	-	180
GJSS Natsugune	Boys	166	-	166
GJSS Tudun bojewa	Boys	360	-	360
GJSS Wapa	Boys	68	-	68
GSCS Airport road	Boys	433	-	433
GSS Darerawa	Boys	240	-	240
GSS Gogau	Boys	148	-	148
GSS Kwakwachi	Boys	170	-	170
GSS Maikwatashi	Boys	198	-	198
GSS MVA Kuka	Boys	240	-	240
GSS Stadium	Boys	311	-	311
ADSS Bokavu Girls	Girls	-	288	288
GASS Masallachi	Girls	-	158	158
GGASS Tudun bojuwa	Girls	-	660	660
GJSS Dan rimi	Girls	-	229	229
GGSS Aisha Shehu	Girls	-	180	180
GGSS Dabo	Girls	-	325	325
GGSS Maikwatashi	Girls	-	360	360
GGSS Maryam Abacha	Girls	-	240	240
GJSS Dan-waire	Co-educ	44	44	88
GJSS Nomansland	Co-educ	71	70	141
GJSS Zawa'i	Co-educ	72	100	172
TOTAL		4,061	2,649	6,715

Sources: (Kano State Senior Secondary School Management Board 2014)

3.4 Sample and Sampling Technique

In selecting the schools for this study, only a sample of seperate male and female schools was used, no co-education school was selected. There are twenty-five junior secondary schools in the study area, 14 male, 8 female and the other 3 are co-educational schools. Two schools were randomly selected from each of the male and female schools.

Simple random sampling technique using balloting method involving a pick from a hat method was used in selecting the sampled schools for this study.

To select students for this study, the researcher used Basic Science Achievement Test (BSAT) as a pretest to determine the subjects ability level as well as the academic level at the beginning of the study. Those who scored less than 40% BSAT were considered with low ability. The researcher randomly selected 120 subjects in line with the central limit theorem, which proposed a minimum of 30 subjects as viable for experimental research (Tuckman, 1975). As mentioned earlier, a simple random sampling technique using balloting method involving picking from a hat was used in selecting the above-mentioned students, where 120 "Yes" was written on a piece of paper and the remaining pieces of paper, "No" was written on them. These pieces of papers were squeezed and put in a large container. After shaking the paper in the container, the study subjects were allowed to come out one by one to pick up one piece of paper from the container and those who picked "yes" were used for this study. Where 60 subjects formed the experimental and 60 subjects formed the control groups. This study focuses on low ability basic science students only, no higher and medium ability basic science student was used. The high and medium ability basic science students were only allowed to view the activities as on lookers.

Table 3.2: Sample for the Study

S/N	Groups	Sample selected based on sex		Total
		Male	Female	
1	Experimental EG_1	30	-	30
2	Experimental EG_2	-	30	30
3	Control CG_1	30	-	30
4	Control CG_2	-	30	30
Total				120

This study consist two groups one experimental (EG) and one control group CG, as contained in table 3.2. In each of the groups, there are two groups that is, in experimental group there is experimental group one (EG_1) which contain 30 male basic science students and experimental group two (EG_2) which contain 30 female basic science students. While the second group, which is control group is also divided into two sub groups that is the control group one (CG_1) which contain 30 male basic science students while the second control group (CG_1) contain 30 female basic science students, in which both the experimental and control groups has a total of 120 low ability basic science students.

3.5 Topics Selected for the Study

For the selection of topics for this study, Basic Science topics were chosen for teaching. New UBE Basic Science for Nigerian Junior Secondary Schools Pupils Book II by STAN with teacher's guide of the same book was used to assist the researcher on how to select the topics and frame the questions. The selected topics are presented as follows;

(a) Work, Energy and Power

(b) Types of Simple machines, The Wheel and axle, Screw thread and Gears.

These topics were selected for the following reasons:-

1. A research conducted in Basic Science by Nwosu and Ibe (2012) showed that topics such as work, energy and power are among the few basic science topics students often fail.
2. Topics like Simple Machines contained several activities that could allow students to work collaboratively in groups.

3.6 Instrumentation

The instruments and the instructional tools used for data collection in this study are as follows;

1. Basic Science Achievement Test (BSAT).
2. Lesson plan for both experimental and control groups.
3. Collaborative Learning Package (CLP).

Basic Science Achievement Test (BSAT) was adapted from Dyel (2011). The test is a twenty multiple-choice objective items. The items were evenly distributed over topics chosen for this study. The marking scheme for this twenty test items was constructed and validated by panel who validated the basic science achievement test (See Appendix A). while the lesson plan used in data collection for both experimental and control group is in Appendix G and H.

3.6.1 Validation of Basic Science Achievement Test (BSAT) and Collaborative Learning Package used for this Study

The content of the Basic Science Achievement Test, Collaborative learning package and Lesson Plans used for this study was validated by a panel of Science Educators who are in the Science Education Department, Ahmadu Bello University, Zaria.

(a) The panel comprised three Science Education Senior Lecturers.

(b) The basic science secondary school teachers with a minimum qualification of first degree and minimum of 5 years teaching experience.

The validation was meant to:

(1) Verify if the items could test what they were supposed to.

(2) Determine the clarity of the language used.

(3) Determine if the difficulty level of the items match the ability levels of the subjects.

(4) Confirm if the items are suitable for use at that level.

(5) To suggest how the items can be modified to make them more suitable if need be.

Question one was corrected, while no correction was made on questions 2-7, and 17 while little corrections were made on questions 8-16, and 18-20 respectively. For example, the language of question 10 was changed as wheel and axle are made in a variety of forms. The common example of this form is -----?. To; what is the common example of wheel and axle? Also question 9 before read, “Simple machines possess” ----, it was corrected to read “Simple machines possess” ----. At the end, they stated that the questions are well framed and in accordance with the JSS II syllabus. In terms of collaborative learning package the validators stated that the researcher should insure to follow the steps or stages as it is contains in the collaborative learning strategy, and the topics used are in

line with Junior secondary school syllabus. After the evaluation of the instrument, it was suggested that the content of the test item was appropriate, and relevant to the objectives of the study.

3.6.2 Basic Science Achievement Test (BSAT)

Basic Science Achievement Test designed for JSS II Basic Science Students by Usman (2000) and Dyel (2011) was adapted. The 20 questions adapted from this instrument were based on the topics selected for this study and were found relevant for the study (see Appendix A). The topics are:

i. Work, Energy and Power

ii. Simple machines (the Wheel and Axle)

iii. Simple machines (Screw thread)

iv. Simple machines (Gears)

The details for the Basic Science achievement test (BSAT) are in Appendix A, the answer sheet of basic science achievement test (BSAT) is in Appendix, B, while the marking scheme is in appendix C. Specification of test items, which reflected topics to be used in the study, is presented in appendix E, while test items reflecting the six cognitive levels based on Blooms (1986); Taxonomy for the cognitive domain is presented in appendix F.

3.7 Pilot Testing

In this study, pilot testing was carried out based on the data of the schools collected from the Kano State Senior Secondary School Management Board. The researcher selected two schools for pilot testing, one boys schools and one girls schools. This was done in schools different from the sampled schools. The schools are Government Secondary School Gogau, having a total of 148 JSS II students where 20 subjects were used for the

pilot testing and Government Girls Secondary School Maryam Abacha with a total of 240 JSS II students where only 20 subjects were used for the pilot testing. The purpose of the pilot study was to ascertain the feasibility and reliability co-efficient of the instrument adapted. When conducting the pilot testing the researcher found that students performed very well when taught in-group activities and most of the schools lacked the instructional materials.

3.7.1 Reliability Coefficient of Basic Science Achievement Test (BSAT)

The reliability co-efficient of the Basic Science Achievement Test (BSAT) was determined using the test retest method, in which the researcher administered the same test twice at an interval of two weeks, and obtained the students' scores. Pearson Product Moment Correlation Coefficient (PPMCC) using statistical package for social sciences (SPSS) of computer was used to analyze the data and the reliability Co-efficient (r) 0.78 was obtained.

3.7.2 Item Analyses of (BSAT), Difficulty/Facility Index and Discrimination Index

The facility index of an item indicates the percentage of candidates that got an item right (Tukman, 1975). For the purpose of standardization of this instrument (BSAT), the difficulty and discrimination indices were determined as follows.

A. Item Difficulty Index

Item difficulty is measured as a percentage of the number of people, candidates, who got the item right over the total number of candidates that attempted the item. To compute the difficulty index for each item in the test, the steps taken are as follows: The researcher rank order the scores on the test from highest to lowest, identify the high scoring group and the low scoring group; The formula used is;

$$P = \frac{R}{T} \times 100$$

P represents the difficulty of an item; R the number of candidates with the item correct and T represent the total number of people that attempted the item. The value of P is in percentage form. Therefore, any candidate with the item right, the fraction would be small and so would the percentage. That would indicate a difficult item. If more candidates got the item correct, the fraction would be bigger and so would the percentage. This would mean the item is easy. In this research any item with difficulty index of between 40%-60 are acceptable. Those with difficulty index of below 40% are rejected as too difficult while those with difficulty index of above 60% are considered too easy and therefore rejected in line with (Sambo 2008). The details of this item difficulty index are in Appendix I.

B. This is used to identify high or low achieving students. The discrimination index of a test is a measure of its ability to discriminate between high and low achievers in a test as a whole. To calculate the discrimination index of an item the researcher arranged all the candidates taking the test in rank order according to their performance on the whole test. Then look at the top 27% of the candidates and see how many of them got the particular item correct. The researcher looked at the bottom 27% of the candidates and sees how many scored the particular item correct. If the item is discriminating in line with the general performance of candidates in the whole test then there should be more candidates in the upper 25% who scored the item correct and less in the lower 25%. The discrimination index is calculated in the following manner:

$D = \frac{RU-RI}{N}$, R_U is the number of candidates with the item correct in the upper 27% of the group; R_I is the number of candidates with the item correct in the lower 27% of the group. In addition, N means the number of candidates in the 27% upper or lower part of the group. Then D is the discrimination index of the item. Therefore, any item with the discrimination of 0.7 – 0.3 were all retained and used for this study in line with (Sambo, 2008). Based on these questions 1, 5,6,12 and 16 were removed and not used for this study because they have discrimination index of 0.2, which shows they are difficult. While little modification was made in question 11, therefore the remaining 20 questions were used for this study and are stated in Appendix A, while Appendix I contains details of the table of items.

3.7.3 Collaborative Learning Package (CLP)

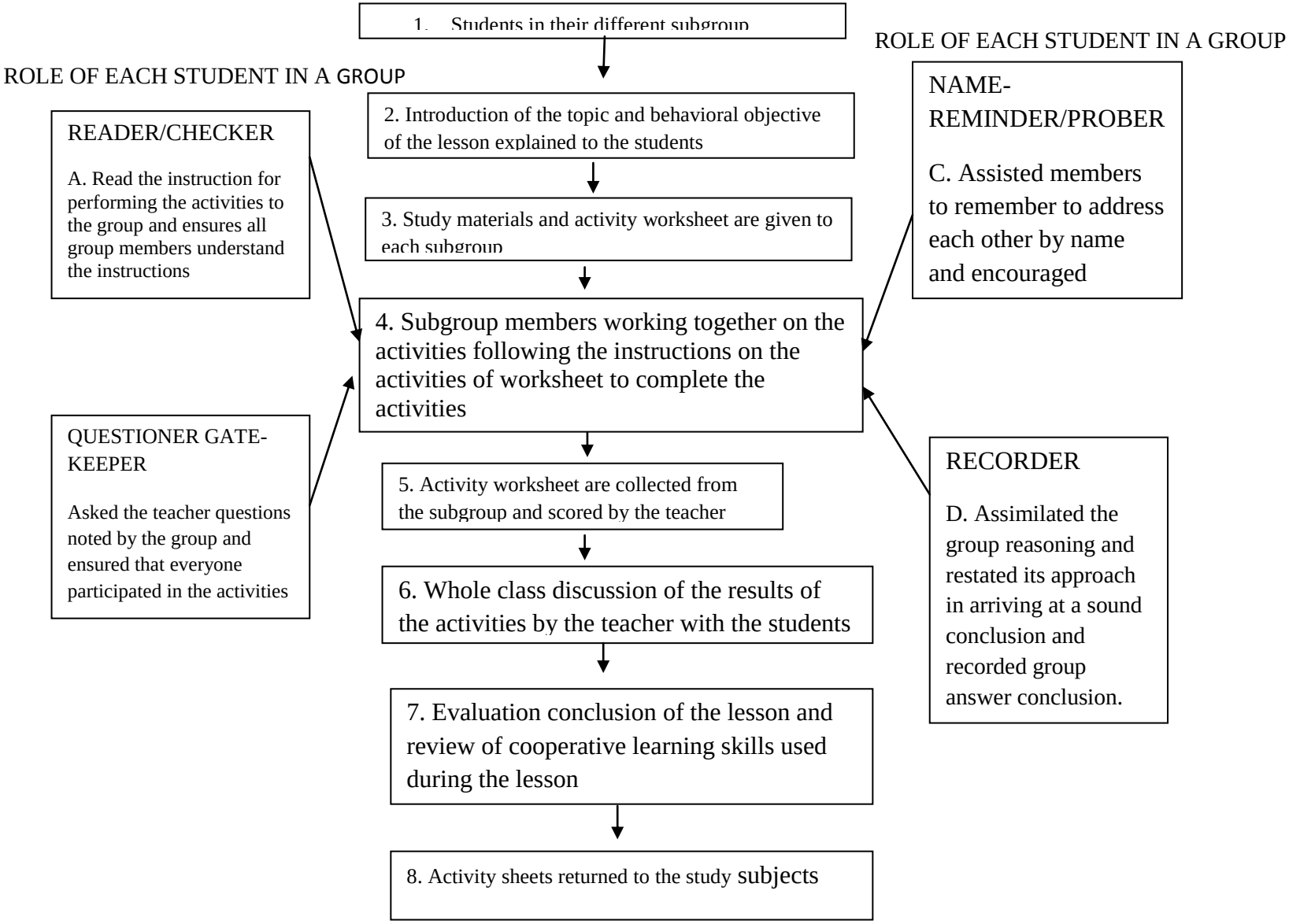
In this study, the researcher adapted collaborative learning package from learning together of Johnson and Johnson (1975) package. The main features of this collaborative learning package is that, members of the class are grouped into four or five members, group worked on a common assignment and submitted a group report to their result. In addition, class work was based on the group work, apart from assigning the group tasks to each group member. The teacher's role was to provide group praises and encouragement, and each group member has a role to play, this role include the reader/checker, who reads to the group the instruction for performing the activities, and also ensures all group members understood the instructions. The questioner/gatekeeper, asks the teacher questions noted by the group and ensures that everyone participated in the activities. While the reminder/prober is another group member, who assists members of the group to remember and to address each other by name and encourage themselves. Finally the

recorder, who assimilated the group reasoning, restated its approach in arriving at a sound conclusion, and records group answer conclusion. This study contains eight activities on "work, energy, power and simple machine". Carefully planned activities that require teamwork among the group members were developed and have been validated as stated above. The validation of both the Collaborative Learning Package and the lesson plans used for this study was stated in 3.6.1. in which the validators stated that researcher should ensure he follows all the steps or stages as it is contained in the adapted collaborative learning package, these stages of collaborative learning package of Johnson (1975) are summarized as follows;

i. Students should assemble themselves in their different subgroup.
ii. Introduction of the topic and behavioral objective of the lesson should be explained to the students.
iii. Study materials and activity worksheet are given to each subgroup.
iv. Subgroup members working together on the activities following the instructions on the activities of worksheet to complete the activities, this is the place where the role of the above stated group members will start which include reader/checker, questioner gatekeeper, name-reminder/prober and recorder.
v. Activity worksheet are collected from the subgroup and scored by the teacher.
vi. Whole class discussion of the results of the activities by the teacher with the students.
vii. Evaluation, conclusion of the lesson and review of collaborative learning skills used during the lesson.
viii. Activity sheets were returned to the study subjects.

while the activities used for this study are as follows;

These steps were used in the preparation of the lesson notes, see Appendix G



Source: Johnson (1975) model adopted by Olorukooba (2001).

Figure 3.2: A Flow Chart of Cooperative Learning Adapted for Collaborative Learning Strategy Model

3.8 Treatment Administration

In this study, the researcher taught the two groups for six weeks and one hour per lesson. The first lesson was used to acquaint the subjects with the collaborative learning strategy. The researcher taught experimental group with collaborative learning strategy, and control group with lecture method. Collaborative learning strategy is an approach, which allows students to interact with study materials in groups. Groups and individual members construct meanings of what is learnt. During the process of the lesson, students collaborated by combining what they learn which helps to bring wider meaning of what they have learnt. During the process of this study the researcher, served as a guide and facilitator to the students. The adopted flow chart of collaborative model used for this study is presented in Figure 3.2

3.9 Data Collection Procedure

This research study aimed at determining the effect of collaborative learning strategy on academic performance in basic science among junior secondary students of low ability in Kano, Nigeria. For the purpose of data collection, the following procedures were used in collecting relevant data.

1. Treatment of the Experimental Group
   a) Train the subjects before exposure to collaborative learning strategy.
   b) Exposure of the experimental group to teaching using collaborative learning strategies (treatment).
   c) Pretest Administration
      a. Training of the subjects for collaborative learning strategy and then teach.
      b. Exposure of the experimental group to posttest

2. Treatment of the Control Group

   a. Exposure of control group to lecture method (control)

   b. Exposure of the study subjects to posttest.

3.9.1 Treatment of the Experimental Group

In this research, teaching and learning of the experimental group was conducted using collaborative learning strategy, because this model enables the researcher to effectively handle the treatment groups. Below are the procedures used in handling the experimental group.

a. Train the subjects before exposure to Collaborative Learning strategy

The teacher informs the subjects of the experimental group about the specific kinds of activities of each group member such as the role of reader/checker, questioner/gate-keeper, reminder/ prober, and recorder, with what was expected of them in collaborative learning class setting. The teacher explained the group role. He further explained collaborative learning skills, such as the use of names, to address the group members; contribution of ideas and suggestions; encouragement of students for their contribution of ideas verbally, and non-verbally among others that would encourage collaboration among the subjects.

b. Exposure of Experimental group to Collaborative Teaching Strategy

The instructional procedure used for the experimental group was based on the adopted flow chart of the cooperative learning strategy model from Johnson (1975). Because Panitz (2013) stated that model of cooperative learning can also be used in collaborative learning, where in collaborative learning, groups would assume almost total responsibility for answering the question. However, the purpose of choosing Johnson

model is that, it involves social processes, by which a small group of students work together to complete an academic problem-solving task designed to promote learning. Collaborative learning package containing explanation of the concepts and activities leading to the phase and stages of flow chart of collaborative learning strategy was given to the subjects. They read and did the activities contained in the package. They also responded to the questions after every activity and help each other after each activity.

Pretest Administration

A pretest was administered before the starting of the treatment. The students in both experimental and control groups were given the pretest on Basic Science Achievement Test (BSAT) by the researcher. The test instrument contained 20 multiple-choice items (BSAT) and each test had four response options. The researcher informs subjects to choose the correct response from the options provided. During the administration of the instrument, the researcher distributed the BSAT to the study subjects. The researcher allows the subjects to read the written instructions on how to answer the test items on the question papers. The researcher explained the difficult areas verbally to the students. The subjects were allowed 40 minutes for the pretest. This was based on the time suggested on the earlier conducted pilot testing. The subject's response in the pretest was collected and scored, using the marking scheme. Each correct response was scored one (5) points with maximum score of twenty (100) marks while the wrong response scored zero. The student's scores from the pretest for the two groups (Experimental and control) were recorded separately and used for the interpretation of the results used for testing both the researcher questions and hypotheses of this study.

c. Training of the Subjects to Collaborative Learning Strategy and then Teach.

Before the subjects went into the classroom for each lesson, the materials needed for the activities of the lesson were placed on the table. Each of the lessons started with the subjects going into their appropriate groups. The cooperative learning instructional package containing explanation of concepts and activities leading to collaborative teamwork was provided to the subjects. The students read and carry out the activities contained in the package. They responded to the questions after every activity. During each lesson, the researcher goes round the class to encourage group members to help those with difficulty in understanding and to explain where no group member is able to help. The following is a flow chart of cooperative model by Johnson (1975), which was used for this study. The stages are:

Stage 1:- At this stage, students are in their different groups that is each student has to go to his own group as instructed by the teacher.

Stage 2:- This is the introduction stage where the teacher will introduce and explain the topic.

Stage 3:- In this stage, the teacher give the study materials and activity worksheets to each subgroup.

Stage 4:- Most of the activities in this flow chart are taking place in this stage, because subgroup members are working together on the activity worksheet to complete the activities, and each student in a group has a role to play. The roles are as follow:

Role A	Reader/Checker will read the instructions for performing the activities to the group and ensure all group members understand the instruction.
Role B	Questioner/Gate-keeper will ask the teacher questions noted by the group and ensure that every one participate in the activities.
Role C	Name – Reminder/Prober, this member will assist members to remember and to address each other by name and encourage his group members.
Role D	Recorder will assimilate the group reasoning and restate its approach in arriving at a sound conclusion and record the group answered conclusion.

Stage 5:- The activity worksheet are collected from the subgroup and scored by the teacher.

Stage 6:- The whole class discussion of the results of the activities by the teacher with the students will take place in this stage.

Stage 7:- In this stage the evaluation and conclusion of the lesson and review of collaborative learning skills used during the lesson will take place.

Stage 8:- In this stage, the teacher will return the activity worksheet to the study subjects for motivation and encouragement of the group members. A flow-chart of Johnson (1975) model used is shown in figure 3.2.

Exposure of the Experimental Groups to Post-test

The teacher administers post-test after completion of the treatment. The students in both experimental and control groups were given the post-test on Basic Science Achievement Test (BSAT). The test instrument contained 20 multiple-choice objective items (BSAT) and each test has four response options. The subjects were allowed to choose the correct response from the options provided. During the administration of instrument, the researcher distributed the BSAT to the study subjects. The researcher allowed the subjects to read the instructions on how to answer the test items on the question papers and the researcher explained the instructions verbally where necessary. The subjects were given 40 minutes for the posttest. This was based on the time suggested during the pilot testing. The subjects' response in the posttest were collected and scored using the marking scheme. Each correct response was scored one (5) points with maximum score of twenty (100) marks while any wrong response attracts zero. The student's scores from the posttest for the two groups (Experimental and control) were recorded separately and used for testing both the research questions and the hypothesis used for this study.

3.9.2 Treatment of the Control Group

In this research study, the control group subjects were handled by researcher. The same topics were taught to them using lecture method, which lasted for six weeks as the

experimental groups. The researcher used the traditional lecture method as described in chapter one and two of this study in teaching the subjects in the control group. Verbal presentation was used during the teaching. The lesson plan was prepared and during the teaching process, important points, which the subjects were expected to write down in their exercise books, were written down on the chalkboard for them to copy. Assignments were given to the subjects after every lesson and they were encouraged to read their textbooks for further clarification and understanding of the lesson. In addition, students were informed to submit the assignment before the beginning of the next lesson, to the researcher. Below are the procedures used in the treatment of the control groups.

a. Exposure of the Control Groups to Posttest

The researcher administered posttest after completion of the treatment. The students in both experimental and control groups were given the posttest on BSAT. The test instrument contained 20 multiple-choice objective items (BSAT) and each test has four response options. Subjects were allowed to choose the correct response from the options provided. During the administration of instrument, the researcher distributed the BSAT to the study subjects. The researcher allowed the subjects to read the written instructions on how to answer the test items on the question papers, and the instructions were explained verbally where necessary by the researcher. The subjects were given 40 minutes for the posttest. This was based on the time suggested during the pilot testing. The subjects' response in the posttest were collected and scored using the marking scheme. Each correct response was scored one (5) points with maximum score of twenty (100) marks while any wrong response carries zero. The student's scores from the posttest for the two groups

(Experimental and control) were recorded separately and used for testing both the research questions and hypothesis used for this study.

3.10 Data Analysis

The data collected for this study was used to test the hypotheses stated in chapter one. Each of the hypotheses is restated below along with the description of the statistical technique used. The level of significance for rejection or retention of the stated hypothesis was set at $P \leq 0.05$

HO_1 There is no significant difference in academic performance of low ability basic science students taught basic science using collaborative learning strategy and those taught using lecture method.

t-test statistics was used to analyze the difference in the academic performance of low ability basic science students before and after exposure to the collaborative learning strategy.

HO_2 There is no significant difference in the academic performance of male and female junior secondary school two students of low ability in basic science expose to collaborative learning strategy.

t-test statistics was used to analyze the difference in the academic performance of male and female junior secondary school two students of low ability in basic science after exposure to the collaborative learning strategy.

HO_3 there is no significant difference in academic performance of female students taught Basic Science using collaborative learning strategy and those taught using lecture method.

t-test statistics was used to analyze the difference in the academic performance of female students taught basic science using collaborative learning strategy and those taught using lecture method.

HO_4 there is no significant difference in academic performance of male students taught Basic Science using collaborative learning strategy and those taught using lecture method.

t-test statistics was used to analyze the difference in the academic performance of male students taught basic science using collaborative learning strategy and those taught using lecture method.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This study investigates the effects of collaborative learning on performance in basic science among low ability students in junior secondary schools in Kano, Nigeria. The data collected were analyzed using the Statistical Package for Social Sciences (SPSS). This chapter is presented under the following subheadings:

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

4.2 Data Analysis and Result Presentation

In this study, four research questions along with corresponding four hypotheses were formulated for answer. Each of the research questions and hypothesis are restated and answered as follows:

Research Question One

What is the difference in the academic performance of low ability students taught basic science using collaborative learning strategy and those taught using lecture method?

The posttest scores obtained were used for analysis using descriptive statistics such as mean and standard deviation. The result is shown in Table 4.1a.

Table 4.1a **Means and Standard Deviations Score for Academic Performance of Low Ability Students of Experimental and Control groups**

Variable	N	$\overline{X}$	SD	Mean different
Experimental	60	81.75	13.56	25.67
Control	60	56.08	7.65	

From Table 4.1a the mean score for experimental group of students exposed to collaborative learning strategy is 81.75 while those who were exposed to lecture method is 56.08. The mean difference between experimental and control groups therefore, is 25.67. This shows that collaborative learning strategy improved academic performance among Basic Science students of low ability.

Hypothesis One:

HO_1 There is no significant difference in academic performance of low ability basic science students taught basic science using collaborative learning strategy and those taught using lecture method.

To test this hypothesis, the posttest scores of students from the academic performance test of the experimental and control group were collated and analyzed using t-test statistical technique to find out if there is any significant differences in their academic achievement at $P \leq 0.05$. The result is presented in Table 4.1b.

Table 4.1b: Results of t-test Analysis of Mean Academic Performance Score of Basic Science low Ability Students for Experimental and Control groups

Variable	N	$\overline{X}$	SD	SE	t-cal	df	p-value	Remark
Experimental	60	81.75	13.56	1.750	7.64	118	0.001	*Significant
Control	60	56.08	7.65	0.988				

* $P \leq 0.05$

The result in Table 4.1b shows that the P-value obtained is 0.00 at $P \leq 0.05$ with df = 118. This implies a significant difference in the academic performance of experimental group exposed to collaborative learning strategy and that of the control group exposed to the lecture method. The result reveals that collaborative learning strategy enhances academic performance of low ability students. Thus, the null hypothesis that stated there is no significant difference is rejected.

Research Question Two

What is the difference in performance of low ability male and female junior secondary school two students taught basic science using collaborative learning strategy differ or not?

To answer research question two, the posttest scores of students from the academic performance test of the experimental and control groups were collected and analyzed using mean and standard deviation. The summary is shown in Table 4.2b

Table 4.2a Means and Standard Deviations Score for Academic Performance of Male and Female Experimental groups

Variable	N	$\overline{X}$	SD	Mean difference
Male	30	81.33	10.66	3.84
Female	30	85.17	13.49	

From Table 4.2a, the result shows that the academic performance of both male and female subjects of experimental groups among junior secondary school two students of low ability in basic science differs. Male subjects have a mean score of 81.33 while the female subjects have the mean score of 85.17. This shows that females performed better with mean difference of 3.84 compared to their male counterparts. Therefore, there is a difference between the performance of the two groups. This result has answered the research question two.

Hypothesis Two

HO_2 There is no significant difference in the academic performance of male and female junior secondary school two students of low ability in basic science exposed to collaborative learning strategy.

To test this hypothesis, the posttest performance scores of the two groups of male and the female students in the experimental group were subjected to t-test analysis. The result is presented in Table 4.2b;

Table 4.2b: **Results of t-test Analysis of post-test Scores of Male and Female low ability Basic Science Students taught using Collaborative Learning Strategy**

Variance	N	$\overline{X}$	SD	SE	t-value	df	p-value	Remark
Male	30	81.33	10.66	1.95				
					1.22	58	0.004	*Significant
Female	30	85.17	13.49	2.46				

* P≤ 0.05

From the result in Table 4.2b, it was observed that the t-value was 1.22, and the P value of 0.004 at degree of freedom 58. Since the P-value of 0.004 is less than P≤ 0.05, therefore, there is significant difference thus, the null hypothesis is rejected. The significant difference is in favour of female students. The results show that female low ability students who were taught basic science using collaborative learning performed better when compared with counterpart male low ability when taught basic science using collaborative learning.

Research Question Three

What is the difference in the academic performance of female low ability students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control)?

Table 4.3a: Means and Standard Deviations of Score for Academic Performance of Female Experimental and Control Groups

Groups	N	$\overline{X}$	Mean difference
Experimental	30	85.33	
			30
Control	30	55.33	

Table 4.3a of descriptive statistics shows that differences exist in the academic performances of female students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control). The calculated mean academic performance of female students of experimental group is 85.33, while that of females' students of control group is 55.33 respectively. This shows that the female students of experimental group had significantly higher academic performance than their females counterparts taught with lecture method, because of the mean difference of 30.

Hypothesis Three

That there is no significant difference in academic performance of female low ability students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control).

To test and analyzed this hypotheses t-test statistics were used.

Table 4.3b: Results of t-test Analysis of Academic Performance of Female Experimental and Control Groups

Groups	N	$\overline{X}$	SD	SE	t-value	df	p-value	Remark
Experimental	30	85.33	13.58	2.48				*Significant
					10.86	58	0.001	
Control	30	55.33	6.69	2.22				

* $P \leq 0.05$

Results from Table 4.3b independent t-test shows significant difference exists in academic performance of female low ability students of experimental group and those of control. Because the calculated P-value of 0.001 is lower than the 0.05 level of significance. This shows that female students of experimental group have significantly higher academic performance compared with their counterparts of control group. Therefore, the null

hypothesis, which stated that there is no significant difference in academic performance of female students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control) is hereby rejected.

Research Questions Four

What is the difference in the academic performance of male students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control)?

Table 4.4a: Means and Standard Deviations of Score for Academic Performance of Male Experimental and Control Groups

Groups	N	$\overline{X}$	SD	Mean difference
Experimental	30	81.33	10.66	
				24.16
Control	30	57.17	8.48	

Table 4.4a shows the mean statistics in the academic performance of male low ability students of experimental group and those of control. The calculated mean of academic performance of both Experimental and Control groups are 81.33 and 57.17 respectively, with a mean difference of 24.16 between them, shows that male low ability students of experimental group have higher academic performance than their male low ability counterparts of control group.

To determine whether the difference is significant, the post-test scores were subjected to t-test for analysis.

Hypotheses Four:

There is no significant difference in academic performance of male students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control).

Table 4.4b: Result of t-test Analysis of Academic Performance of Male Experimental and Male Control Groups

Groups	N	$\overline{X}$	SD	SE	t-value	df	p-value	Remark
Experimental	30	81.33	10.67	1.95	9.72	58	0.001	*Significant
Control	30	57.17	8.48	1.55				

*P≤ 0.05

Independent t-test statistics of Table 4.4b shows that significant difference exists in academic performance of male low ability students of experimental group and those of control group. Because the calculated p-value of 0.001 is lower than the 0.05 level of significance. This shows that male low ability Basic Science students of experimental group have higher academic performance compared with their male low ability counterparts of control group. Therefore, the null hypothesis, which stated that there is no significant difference in academic performance of male low ability students taught Basic Science using collaborative learning strategy (experimental) and those taught using lecture method (control), is hereby rejected.

4.3 Summary of Findings

In this study, the following findings were obtained,

(1) There is significant difference in the mean scores of experimental and control group, that is Basic Science students of low ability taught using collaborative

learning performed better when compared with the mean scores of low ability Basic Science students taught Basic Science using lecture method.

(2) The finding of this study shows that there is a significant difference in the mean scores of female low ability and male low ability students taught Basic Science using collaborative learning. The difference is in favour of the female low ability students as they scored higher mean scores than the male low ability students.

(3) There is a significant difference in the mean scores of the female low ability students taught basic science using collaborative learning and those low ability students taught basic science using lecture method. The result is in favour of the female low ability taught basic science using collaborative learning strategy.

(4) There is a significant difference in the mean scores of the male low ability students taught basic science using collaborative learning and those taught basic science using lecture method. The male low ability students taught basic science using collaborative learning strategy performed better than those low ability students taught using lecture method.

4.4 Discussion of Findings

The results in Tables 4.1b show that the experimental group, which was exposed to collaborative learning strategy, performed better than their counterpart in the control group who were taught using lecture method. The finding of this study is in line with that of Davis (1993), which suggests that the students learn better when actively involved in the collaborative learning. In addition, students who collaborate in a group seem to be more satisfied with their course. Furthermore, in study on competitive and collaborative learning in senior secondary schools by Kolawole (2007), the findings of the study showed that

academic performance of the students were highly improved. In a separate studies by Slavin (1996) and Gokhale (1995) it is shown that when students work in collaborative learning, they engage in active learning which required them to use critical thinking, and fostered the development of critical thinking. Johnson and Johnson (1989) highlighted that collaborative learning increases students' abilities in leadership and effective communication as well as enable them to manage conflicts constructively. Also in support of this study, the findings of Webb (2008), Lakpini (2012), Olorukooba and Lawal (2010) believed that small group interaction enhances the performance of low ability students and students who collaborate and work together as a team results in the positive performance. This clearly shows that the higher performance is in favour of experimental group, which suggests that the collaborative learning strategy is more effective than the lecture method of teaching.

The results in Table 4.2b shows that there is a significant difference in the academic performance of low ability male and female junior secondary school two students when taught Basic Science using collaborative learning strategy. This finding is in agreement with the findings of Nwanso (2004), Batin (2000),Yager, Mackunnu and Yager (2005), Onu (2007),Wakili (2007), who in their separate studies, described that using activity oriented teaching strategies increased students abilities to come up with divergent view on issues hence their creative ideas improved. Curtis & Lawson, (2001) in their study showed that male and female students who were exposed to collaborative learning, had an increase in their involvement and critical thinking as well as understanding of the subject matter. Furthermore, this is in agreement with findings of Mari (1994) and Bichi (2008) where they separately stated that girls performed better than the boys in problem solving

type of activity. However, Gipps (1994), and O'Connor (2001), found that as boys and girls grew up, the differences they have in achievement in other subjects tend to diminish except in the sciences, and mathematics. In addition, this finding is in deviations with the findings of Ogunkola (1999) and Usman (2007), where in their separate findings they found out boys' performance is better in any rigorous work while girls showed to settle for less rigorous work. In other related studies, Billings (2000), and Kolawole (2007) in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. In addition, Alfa (2007) reported that most researchers found boys performing better than girls especially in higher order knowledge. Joel and Sesugh (2006) found that boys perform better than girls in chemistry problem solving which requires the use of mathematics. However, Onekutu (2002) also added that science in most cultures is defined as a masculine domain. But Yoloye, (2004) opined that if boys and girls are given equal opportunities they will perform equally well. This clearly shows that the higher performance is in favour of experimental group, which suggests that the collaborative learning strategy is more effective than the lecture method of teaching. Based on these, therefore Usman (2010) stated that the issue of a gender in science teaching seems to be a controversy.

In addition, the results obtained from Table 4.3b, show that low ability female students taught basic science using collaborative learning performed better than the low ability female students taught basic science using lecture method. The finding of this study is in agreement with the finding of Dambana (2011) where he found that female students taught using STS performed better than the female students taught using the traditional lecture method. Also, this finding is in line with the finding of Muhammad (2014) which

found that students taught using collaborative learning performed better. This shows that collaborative learning enhances the academic performance of low ability female students who are exposed to collaborative learning.

The results obtained from Table 4.4b show that low ability male students taught basic science using collaborative learning strategy have significantly higher academic performance than their low ability female counterparts taught using lecture method. This is in line with finding of Dambana (2011) where he found that the male students taught using Science-Technology and Society (STS) performed better than male students taught using the traditional lecture method. In another direction, this finding is in line with the findings of Dyel (2011) and Sadi (2014) found that collaborative learning strategy enhances the academic performance of students. This shows that low ability male students taught basic science using collaborative learning strategy have significantly higher academic performance, than low ability male counterparts taught with lecture method.

The results of these study show that low ability students when taught basic science using collaborative learning strategy were observed to generate more positively for the students performance in basic science. The results further shows that low ability female students performed better when compared to their counterpart low ability male students. Consequently, this learning strategy holds a viable promise for improving teaching and learning process of basic science of low ability students at the junior secondary school level.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study investigates the effects of collaborative learning strategy on Performance among low ability junior secondary students basic science students in Kano, Nigeria. This chapter is discussed under the following sub-headings:

- Summary
- Summary of the Findings
- Implication of the Findings to the Science Education
- Conclusions
- Contributions to Knowledge
- Recommendations
- Limitations of the Study
- Suggestions for Further Studies

5.2 Summary

The main objective of this study was to investigate the effect of the collaborative learning strategy on performance among low ability junior secondary school basic science students Kano, Nigeria. The study was Quasi-Experimental control design in nature, involving direct teaching by the researcher of the experimental and control groups using collaborative learning and lecture methods respectively. A simple random sampling technique was used in selecting four secondary schools among secondary schools in Kano metropolis. That is to say: two schools were sampled for the experimental study, comprising one boys' school and one girls' school. The schools are Government Secondary School, Dabo, and Government Girls Secondary School, Danrimi where 60 low

ability students were selected from these two schools and used as experimental groups. The two control school sampled are Government Arabic Secondary School, Kwachiri and Government Girls Arabic Secondary School, Masallachi where 60 low ability students were selected and used for this study. The total of 120 low ability basic science students were used for this study. The study used experimental – control groups design, involving pretest and posttest. The pretest was used to determine the equivalence of the subjects before the treatment and the posttest after the treatment. The research instrument used was Basic Science Achievement Test (BSAT), which was used as both Pretest and Posttest. The data collected from the achievement test from hypotheses 1, 2, 3 and 4 was analyzed using t-test statistics at $P \leq 0.05$ significant level.

5.3 Summary of Major Findings

In this study, the following findings were obtained,

(1) The mean score of low ability basic science students who were taught basic science using collaborative learning strategy is better than those taught using lecture method. This shows that low ability students in the experimental group performed better than those in the control group.

(2) The result further shows there is better performance in academic performance of low ability male students and low ability female basic science students exposed to collaborative learning strategy, in favour of low ability female Basic Science students. This shows that there are gender related differences in the academic performance of low ability students taught Basic Science using collaborative learning strategy.

(3) There is an improvement in the academic performance of low ability female students taught basic science using collaborative learning than those low ability female students taught basic science using lecture method.

(4) The findings also showed that the mean score of the low ability male basic science students who were taught basic science using collaborative learning strategy is better than those low ability male basic science students taught basic science using lecture method.

5.4 Conclusions

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

1. Low ability basic science students exposed to collaborative learning strategy performed better in basic science than those low ability basic science students who are exposed to the lecture method of teaching.
2. Collaborative learning strategy enhanced the performance of low ability female students in basic science than the male. Generally, collaborative learning strategy has the potential of enhancing low ability basic science students' performances.

   In conclusions, using collaborative teaching strategy for the improvement of Science Education at the JSS level is a welcome idea, and collaborative learning strategy has the potentiality of enhancing low ability students' academic performance in Basic Science at junior secondary school level.
3. Female low ability students who were taught basic science using collaborative learning strategy performed better when compared with the low ability female students taught basic science using lecture method.

4. Male low ability students taught basic science using collaborative learning performed better when compared with the low ability male students taught basic science using lecture method.

5.5 Contribution to Knowledge

The result and the findings of this study have made the following contribution to knowledge.

1. The findings of this study reveal that collaborative learning strategy improved performance of both male and female low ability basic science students with the female performing better.
2. The study established that collaborative learning strategy improved performance of low ability basic science students' academic performance, therefore collaborative learning is gender friendly.
3. Another contribution to knowledge of this study is the validation of research instruments and development of collaborative learning package.

5.6 Recommendations

Based on the conclusions from this study, the following recommendations have been formulated:

1. Collaborative learning strategy enables the low ability students to performance better in Basic Science; therefore using this learning strategy would enhanced teaching and learning of the subject, and as such should be used to teach low learners.
2. This study would help Curriculum planners to examine the effectiveness of collaborative learning strategy, and consider its suitability for the teaching of

Basic Science concepts. Since it has the potentiality of bringing about meaningful learning and improved academic performance of low ability students, educational administrators as well as the principals and teachers of secondary schools should use it as the point of reference in formulating other educational policies in Basic Science.

3. Conferences, seminars and workshops should be organized by professional associations, professional bodies and research organizations like the Science Teachers Association of Nigeria (STAN) and The Nigerian Educational and Research Development Council (NERDC) to incorporate collaborative learning strategy in Basic Science curricula and textbooks at both the Junior and the Senior Secondary School levels.
4. Federal, State and Local government should assist in the provision of necessary materials for effective use of Collaborative learning for the teaching of basic science.
5. Non-Governmental Organizations (NGOs) and Parent Teachers Association (PTA) should supplement and compliment government effort by providing materials for effective use of teaching strategy for the teaching of basic science.

5.7 Limitations of the Study

This study has the following limitations:

1. This study used only selected concepts drawn from *Nigeria Basic Science Pupils Book II* e.g work, energy, power and simple machine. Therefore, it is difficult to generalize the study to all Basic Science topics.

2. High, medium or varied ability basic science students was not used in this study; only low ability Basic Science students were involved in this study due to their peculiar problem in learning Science.
3. This study was restricted to only four Junior Secondary Schools in Fagge Local Education Authority of Kano State, containing 120 study subjects, which is a small sample. Therefore, the scope of the generalizations derived from this study is narrow.
4. A lot of time was spent on explaining and subsequently involving students in the process of this study, because low ability basic science students are not quite conversant with the collaborative learning strategy.

5.8 Suggestions for Further Studies

1. Similar study could be carried out on collaborative learning and students' academic performance on higher and average abilities.
2. In addition, similar study could be conducted in senior secondary school level to find out the effect of collaborative learning strategy on the academic performance on low ability students at senior secondary levels of education in some science subjects.
3. Similar study could also be conducted in tertiary institutions to find out the effect of collaborative learning strategy on the academic performance and on low ability students at higher levels of science education.

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APPENDIX A
Basic Science Achievement Test (BSAT) for Junior Secondary School Students (JSS II)

Time allowed 40 minutes

Dear Respondent,

The purpose of the test is purely research and not to test you or your school performance. Your honest response will be a contribution to the improvement of science education. Read the questions carefully. Each question is followed by four options (A-D). One option is correct. You are to tick the correct option on your answer sheet.

1. Energy can be described as ----------
   a. Ability to do work
   b. Anything that changes the position of a body
   c. Distance moved in the direction of the uniform motion
   d. None of the above

2. Energy is transferred when ----------
   a. Work is not done
   b. A body is in stagnant motion
   c. Work is done
   d. A body is in resting stage

3. Which among these is the formula of power ---------
   a. $\text{Power} = \frac{\text{time}}{\text{energy}}$

   b. $\text{Power} = \frac{\text{work done}}{\text{time taken}}$

   c. Power = Force × distance

   d. None of the above

4. Calculate the work done when a person pushes a car from its stationary position to a distance of 50m applying a force of 200N?
   a. 5,000 joules
   b. 10,000 joules
   c. 15,000 joules
   d. 20,000 joules

5. ---------- is the energy possessed by a moving body.
    a. Potential energy
    b. Kinetic energy
    c. Light energy
    d. Solar energy

6. Which among these form of energy is found in a object when that object is in stagnant position ----------
    a. Kinetic energy
    b. Potential energy
    c. Mechanical energy
    d. None of the above

7. ---------- is the point where force is applied
    a. Load
    b. Effort
    c. Work
    d. Fulcrum

8. The load is the point where work is ----------
    a. Overcomes
    b. Not overcomes
    c. In stagnant stage
    d. In resting stage

9. Simple machines possess such as ----------
    a. 2 classes of levers
    b. 3 classes of levers
    c. 4 classes of levers
    d. 5 classes of levers

10. What is the common example wheel and axle ------
    a. Fulcrum
    b. Windlass
    c. Effort
    d. None of the above

11. Simple machines are commonly called ----------
    a. Levers
    b. Power
    c. force
    d. wheel

12. Which of these is not a component of a screw?
    a. Handle
    b. Plane
    c. Thread
    d. All of the above

13. Which among these is among the uses of a screw in simple machines?
    a. Making holes in a soft objects
    b. Making holes in a hard objects
    c. None of the above
    d. Breaking hard objects

14. All of these are examples of screws except----------
    a. Nuts
    b. Car jack
    c. Spanner
    d. Scissors

15. What type of screw is used in lifting a car?
    a. The carpenters screw
    b. The car jack
    c. The nut
    d. None of the above

16. Which of the following part of screw is considered very important for drilling holes?
    a. Handle
    b. Thread
    c. Plane
    d. None of the above

17. A gear transfers energy from the engine to the----------
    a. Driving wheel
    b. Gear box
    c. Toothed wheels
    d. Driven wheel

18. Application of gears can be observed in----------
    a. Vehicles and crushing machines
    b. Non working machine
    c. All of the above
    d. None of the above

19. Driving wheel and driven wheel are examples of----------
    a. Screw
    b. Gear
    c. Axle
    d. Fulcrum

20. Driving wheel and driven wheel generally result for the engine in the machine to----------
    a. Rotates
    b. Not rotates
    c. None of the above
    d. In stagnant positions

APPENDIX B

Basic Science Achievement Test (BSAT) Answer Sheet

Instruction

Read each question carefully and four possible answers were provided after each question. Choose the correct one answer and enter it on the answer sheet by shading the letter A, B, C or D that corresponds to your choice.

Example

Suppose you choose letter C for question 1 so you should shade letter C as shown below:

1 A,B,·C,D.

School_____

Class_____

Basic Science Achievement Test (BSAT).

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

APPENDIX C

Marking Scheme for Basic Science Achievement Test (BSAT)

1. A

2. C

3. B

4. B

5. B

6. A

7. A

8. B

9. B

10. B

11. A

12. B

13. B

14. C

15. B

16. B

17. A

18. A

19. B

20. A 1 MARK EACH X 20 = 20 MARK

APPENDIX D

Classification of Activities to be used for this Study

In this study, the researcher developed a Collaborative Learning Package which contains eight activities on "work, energy, power, and simple machine". Carefully planned activities that would require teamwork among the group members were developed such as:

Activity I: Discussing on work and force.

Activity 2: Discussing and calculating of power.

Activity 3: Discussing on work, power, energy, demonstrating kinetic, and potential energy.

Activity 4: Identifying and discussing on simple machines (wheel and axle).

Activity 5: Discussing on the operation of wheel and axle.

Activity 6: Making a paper screw thread.

Activity 7: Demonstrating the use of a screw.

Activity 8: Describing gears, and how the gear works.

In developing these activities the New UBE Basic Science for Nigerian Junior Secondary Schools Pupils Book II edition (Longman 2009) and edited by (STAN) with teacher's guide of the same book are used as references. The face content validities of the activities have been carried out by three senior science educators from Ahmadu Bello University, Zaria with Basic Science background, and with Ph.D degree also with two Basic Science secondary school teachers. Some activities where changed, and the corrected ones were used in this study. While the details for the classifications of activities used for this study are in Appendix D. The following are the features of Collaborative Learning Package used for this study:

- Step I:-The students are assigned into 5 different homogeneous academic ability groups.

Each subgroup comprised 5 subjects to allow for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. These would be made possible by using students basic science achievement test (BSAT) results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.
- Step III: - The teacher introduced the activities and emphasized the need for each groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;
  - i. The use of name when addressing group members;
  - ii. Contributions of ideas and suggestions;
  - iii. Encouragement of the contribution of ideas verbally and non-verbally;
  - iv. Checking understanding of others;
  - v. Keeping the group in order;
  - vi. Active listening skills;
  - vii. Summarizing;
  - viii. Paraphrasing;
  - ix. Group decision making;
  - x. Acknowledge contribution verbally and non-verbally.
- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.
  - i. Team leader ensures all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

● Step v:-Each group leader reads out the activity of their group.

While the worksheet of each lesson is presented below:

Worksheet of each Lesson

Lesson One

Activity I: Discussing on work, and force.

You are provided in your group with the following equipment; stone of 5kg.

► Carefully examine the instrument.

► This is a group work of five students. You are to work with other students in your group.

► A stone of mass of 25kg is raised through a vertical height of 3.5m by five students. (acceleration due to gravity is $10m/s^2$) ?

► Calculate work using the formula which says work = mass × acceleration × distance.

Lesson Two

Activity 2:- Discussing and calculating of power.

You are provided with the following equipment; load of 3kg.

► carefully examine the instrument.

►this is a group work of five students. You are to work with other students in your group.

►Four students, AB and CD, pushed the same load of about 3kg through the same distance of 50m. Whereas AB did the work in 45 seconds, CD took 60 seconds.

► Calculate the power of AB and CD, using the formula, which says Power $= \frac{\text{work done}}{\text{time taken}}$.

► Which of the students AB and CD is more powerful than the other?

► What is

(i) Work? ----------
---------.

(ii) Force? ----------

(iii)Power?----------

Lesson Three

Activity 3: Discussing on work, power and energy, with demonstrating kinetic and potential energy.

You are provided with the following equipments; Metal balls A, B, C and D. load of 1kg.

► Examine the instruments carefully.

► This is a group work of five students.

► Four metals balls A, B, C, and D whose masses increase from A to D.

► Place the bigger metal ball B at top of a slope and metal ball A at the lower side of the slope.

► Role ball B such that it hits ball A.

► Write down what you observe below.

► Repeat this with the smaller ball now at the top of the slope and the bigger one at the lower side of the slope. To see the evidence that work is done is when ball B hits ball A, it pushes ball A from its stationary position, causing it to move. Sound, which is another form of energy may also be produced.

► What is the importance of energy?

► Write down five sources of energy.

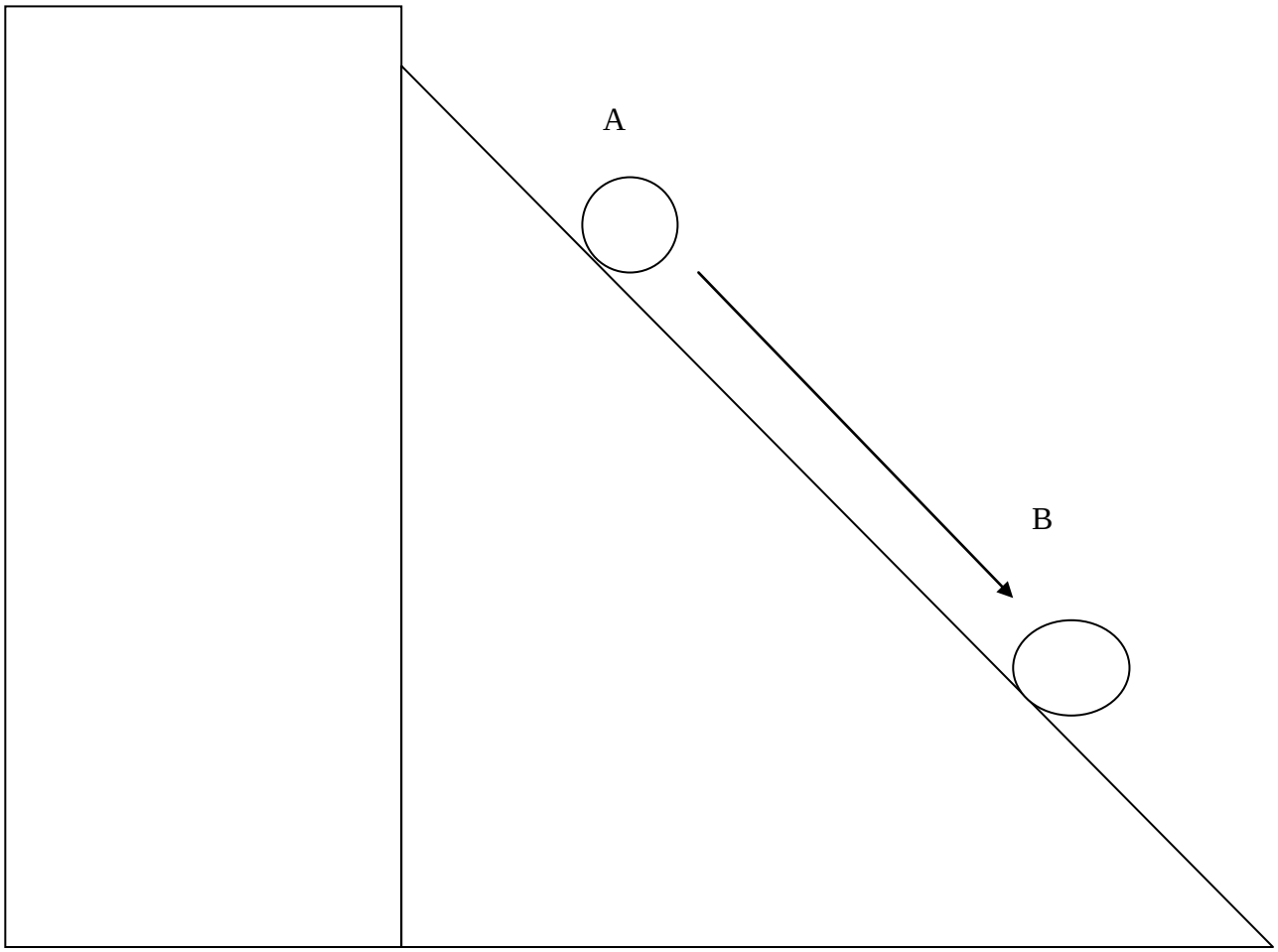
(i) ---

(ii) ---

(iii) ---

(iv) ---

(v) ---



Illustrating potential and kinetic energy

Lesson Four

Activity Four: Identifying and discussing on simple machines (wheel and axle).

You are provided with the following equipment in you group; knives, fork, Spoon, axe, hoe, scissor, broom, pliers, hammer in you group.

.► Carefully examine each of them.

► Your group consist of five students.

► complete the table below on what home tools fit into the arrangement of first, second and third class levers?

Tool	Lever arrangement	Lever class
a- Knives		
b- Fork		
c- Spoon		
d- Axe		
e- Hoe		
f- Scissor		
g- Broom		
h- Pliers		
i- Hammer		

► What is simple machine? Give an example.

---.

► Name five simple machines that are used at home.

(i) ---
(ii) ---
(iii) ---
(iv) ---
(v) ---

► List three essential parts of a lever.

(i) ---
(ii) ---
(iii) ---

► Name three classes of lever.

(i) ---
(ii) ---
(iii) ---

Activity Five: Discussing on the operation of wheel and axle.

You are provided with the following equipments in your group; Rope, Rim of the large wheel, a load.

► Carefully examine each of them.

► The first part is the large wheel of radius R that is also grooved to take a rope..

► When effort is applied by means of a rope attached to the rim of the large wheel, the rope would round the axle of the smaller wheel in the opposite direction raises the load.

► For each complete rotation of the large wheel, there is a complete rotation of the axle.

► Thus, in every complete rotation, the load moves a distance equal to the circumference of the wheel.

► in principle, a load like a bucket of water in a well can be lifted out of the well with effort applied on the rope hanging from the wheel. By pulling on the rope, the bucket of water is lifted from the well.

► All completed recorded activities by each subgroup on the answer sheet are to be collected from subgroup leaders and marked by the researcher.

►Describe the wheel and axle.

-

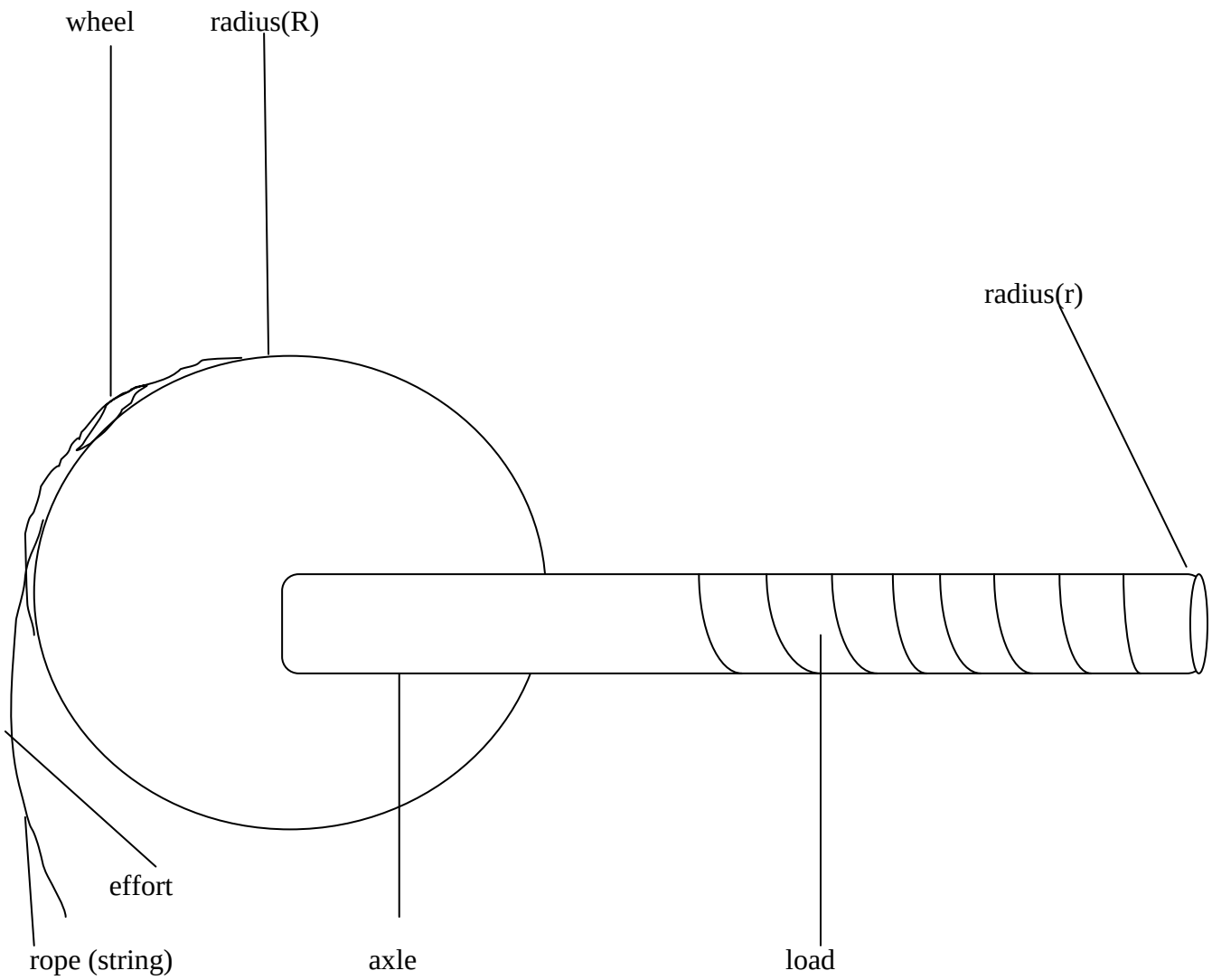


Diagram to show how the wheel and axle works

Lesson Five

Activity Six: Making a paper screw thread.

You are provided with the following materials in your group; pencil, paper and scissors.

► carefully examine each of them.

►your group is made up of five students.

►your group is instructed to Place a pencil on top of a paper and cut the paper into a

rectangular equal to the length of the pencil.

► Cut the rectangle into a triangle so that it looks like an inclined plane.

► Wrap the paper around the pencil. What you have is paper screw thread.

► The teacher goes round and help the subjects in each subgroup participate actively.

Activity 7: Demonstrating the use of screws.

In your group, you a provided with the following materials; piece of wood and a screwdriver.

► carefully Examine each of these instrument.

► Hold the screwdriver with your right hand.

► Drill the screwdriver into the wood.

► Record your observation.

► Take the same wood; try to drive a nail into it with your hand.

► Record your experience.

You might have noticed the ease with which the screw moved into the wood.

► List three kinds or forms of screw.

(i) ---

(ii) ----------

(iii) ----------

► Teacher goes round and remain with the subjects to contribute actively for the entire success of their group.

► All completed activities by each subgroup are to be collected from their group leaders and marked by the teacher.

Lesson Six

Activity Eight: Describing gears and how the gear works.

In your group, you are taking a trip by your teacher to motorcycle mechanics in order to see how gear works.

► What is a gear?

► Ask the mechanic to show you a gear.

► Identify the parts of the gear (the driving wheel and the driven wheel).

► Ask the mechanic to show you how the gear works and write it down.

► Record what you observed and ask below:

► Write down four uses of gears.

(i) ----------

(ii) ----------

(iii) ----------

(iv) ----------

► All completed activities by each subgroup are to be collected from the group leaders and marked by the teacher.

APPENDIX E

Specification of Items (Topics used in this study)

S/N	TOPICS	NUMBER OF THE ITEMS CHOSEN	TOTAL
1	Work, Energy and Power	1,2,3,4,5,6	6
2	Simple Machines (Wheel axle)	7,8,9,10	4
3	Simple Machine (Screw Thread)	11,12,13,14,15	5
5	Simple Machine (Gears)	16,17,18,19,20	5
		Total	20

APPENDIX F

Table of Specification

S/N	Content	Knowledge (50%)	Comprehensive (15%)	Application (15%)	Analysis (15%)	Synthesis (0%)	Evaluation (5%)	Total (100%)
1	Work, Energy and Power (30%)	3	1	-	1	-	1	30%
2	Simple Machines (Wheel and Axle) (20%)	3	-	-	1	-	-	20%
3	Simple Machines (Screw thread) (25%)	3	2	-	-	-	-	25%
4	Simple Machines (Gears) (25%)	1	-	3	1	-	-	25%
TOTAL	(100%)	10	3	3	3	0	1	20

APPENDIX G

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan one

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

Subject: Basic Science

Topic: Work

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Stone of 25kg.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the term work

(II) Use the formula in calculating work

(III) Explain the relationship between work and force

Previous knowledge: Students have a little knowledge about the meaning of work, and Force.

Introduction: The lesson was introduced by asking all the students of these respected groups to explain the meaning of work?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into five different homogeneous academic ability groups.

  Each subgroup comprised only five students for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. This would be made possible by using students Basic Science Achievement Test (BSAT) results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.

- Step III: - The teacher introduced the activities and emphasized the need for each sub groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as:

  i. The use of name when addressing group members;

  ii. Contributions of ideas and suggestions;

  iii. Encouragement of the contribution of ideas verbally and non-verbally;

  iv. Checking understanding of others;

  v. Keeping the group in order;

  vi. Active listening skills;

vii. Summarizing;

viii. Paraphrasing;

ix. Group decision-making;

x. Acknowledge contribution verbally and non-verbally.

- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.

i. Team leader makes certain all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

- Step v:-Each group leader reads out the activity for the group as presented below.

Activity I: Discussion on work, and force.

You are provided in your group with the following equipment; stone of 5kg.

► Carefully examine the instrument.

► This is a group work of five students. You will work with other students in your group.

► A stone of mass of 25kg is raised through a vertical height of 3.5m by five students. (acceleration due to gravity is $10m/s^2$).

► Calculate work using the formula which says work = mass × acceleration × distance.

Evaluation: The teacher asked the students the following questions; e.g

(i) What is work?

(ii) Calculate the work done when a mass of 5.00kg is raised through a vertical height of 2.5m (acceleration due to gravity is $10m/s^2$)?

(iii) What is force?

(iv) What is the relationship between work and force?

Conclusion: The teacher conclude the lesson by explaining to the students briefly the main points in the lesson i.e what is work and explaining relationship between work and force. Teacher informs the students that the next topic will be on power.

Assignment: The teacher informs the students to read more about the power and the relationship between work and power.

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan Two

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

Subject: Basic Science

Topic : Power

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Load of 3kg and 5kg, stopwatch.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the power

(II) Explain the relationship between work and power

(III) Calculate power using formula

Previous knowledge: Students have idea about the work.

Introduction: The lesson was introduced by asking the whole students of these respected groups, what is the meaning of power?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into five different homogeneous academic ability groups. Each subgroup comprised five students to allow for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. This would be made possible by using BSAT results.
- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.
- Step III: - The teacher introduced the activities and emphasize the need for each sub groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;
  - i. The use of name when addressing group members;
  - ii. Contributions of ideas and suggestions;
  - iii. Encouragement of the contribution of ideas verbally and non-verbally;
  - iv. Checking understanding of others;
  - v. Keeping the group in order;
  - vi. Active listening skills;
  - vii. Summarizing;
  - viii. Paraphrasing;
  - ix. Group decision making;

x. Acknowledge contribution verbally and non-verbally.

- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.

i. Team leader makes certain all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

- Step v:-Each group leader reads out the activity for the group as presented below.

Activity 2: Discussion and calculation of power.

You are provided with the following equipment; load of 3kg.

► carefully examine the instrument.

►this is group work of five students. You were to work with other students in your group.

►Four students, AB and CD, pushed the same load of about 3kg through the same distance of 50m. Whereas AB did the work in 45 seconds, CD took 60 seconds.

► calculate the power of AB and CD, using the formula, which says Power $= \frac{\text{work done}}{\text{time taken}}$.

► which of the students AB and CD is more powerful than the other?

Evaluation: The teacher ask the students the following questions; e.g

(I) What is power?

(II) Calculate the power if two students, A and B, pushed the same load of about 5.00kg through the same distance of 50m, whereas A did the work in 45 seconds and B took 50 seconds?

Conclusion: The teacher conclude the lesson by explaining to the students briefly the main points in the lesson i.e what is power and explain how to calculate power using formula which says Power $= \frac{\text{work done}}{\text{time taken}}$.

Teacher informs the students that the next topic will be on energy.

Assignment: The teacher informs the students to read more about the energy and its sources.

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan Three

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

Subject: Basic Science

Topic: Energy

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Load of 1kg, metal balls A, B, C, D.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the energy

(II) List and explain different forms of energy e.g solar, heat, light, mechanical, kinetic, potential, electrical, chemical and sound energy.

(III) Calculation on work, energy and power.

Previous knowledge: Students have idea about the work and power.

Introduction: The lesson was introduced by asking the students of these respected, what is the meaning of energy?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into five different homogeneous academic ability groups.

  Each subgroup comprised 5 students to allow for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. This would be made possible by using BSAT results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.

- Step III: - The teacher introduced the activities and emphasized the need for each groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;

  i. The use of name when addressing group members;

  ii. Contributions of ideas and suggestions;

  iii. Encouragement of the contribution of ideas verbally and non-verbally;

  iv. Checking understanding of others;

  v. Keeping the group in order;

  vi. Active listening skills;

  vii. Summarizing;

  viii. Paraphrasing;

ix. Group decision making;

x. Acknowledge contribution verbally and non-verbally.

- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.

i. Team leader makes certain all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

- Step v:-Each group leader reads out the activity for the group as presented below.

Activity 3: Discussing on work, power and energy, and demonstrating kinetic and potential energy.

You are provided with the following equipment; Metal balls A, B, C and D. load of 1kg.

► Examine the instruments carefully.

► This is a group work of five students.

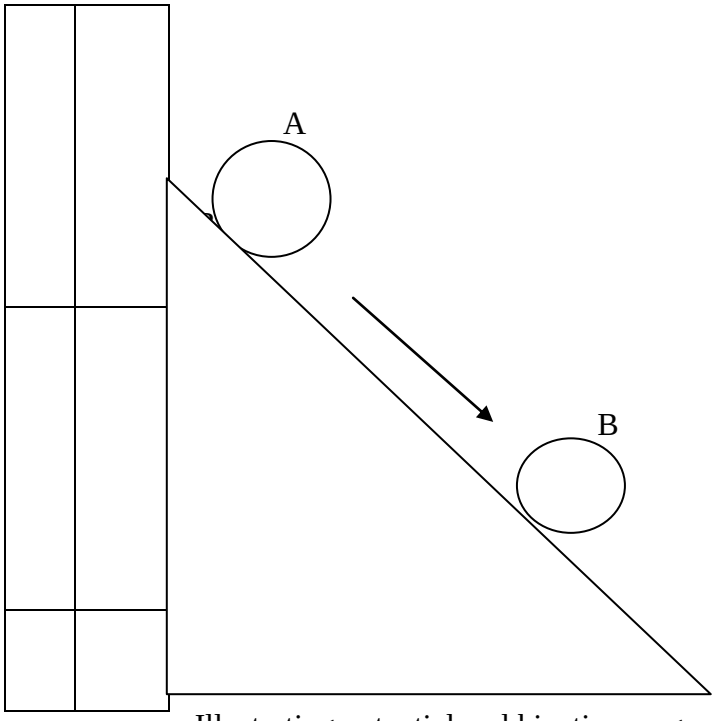
► Four metals balls A, B, C, and D whose masses increase from A to D.

► Place the bigger metal ball B at top of a slope and metal ball A at the lower side of the slope.

► Role ball B such that it hits ball A.

► Record your observation.

► Repeat this with the smaller ball now at the top of the slope and the bigger one at the lower side of the slope. The evidence that work is done when ball B hits ball A, it pushes ball A from its stationary position, causing it to move. Sound, which is another form of energy may also be produced.



Illustrating potential and kinetic energy

Evaluation: The teacher asks the students the following questions; e.g

(I) What is energy?

(II) Suppose in your group, an object was dropped with a known mass of 1kg through a known height of 2metres to the floor. Discuss the types of energy

changes that occur when the object is dropping and the type of energy it has when it has finally reached the floor.

Conclusion: The teacher conclude the lesson by explaining to the students briefly the main points in the lesson i.e. what is energy and explain different forms of energy. Shows students how to calculate Power-using formula, which says:

$$\text{Power} = \frac{\text{work done}}{\text{time taken}} \quad \text{and work done} = \text{mass} \times \text{distance},$$

Where; kinetic energy = mass × acceleration due to gravity × distance.

Teacher informs the students that the next topic will be on simple machines (wheel and axle).

Assignment:- The teacher informs the students to release a ball freely through a distance (h) to touch the ground after time (t) and write down what you observe.

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan Four

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

Subject: Basic Science

Topic : Simple Machine (Wheel and Axle)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Screw driver, Hammer, Scissors, pliers, wheel barrow, Knives, fork, Spoon, Broom and Hoe, Rope, Rim of the large wheel, a load.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Explain the meaning of Simple Machines with its examples

(II) Explain the Meaning of Levers and show physically the classes of Levers

(III) Explain the meaning of wheel and axle with its examples

(IV) Differentiate the work of wheel and axle in simple machine.

(V) Demonstrate practically the operation of wheel, axle and their uses.

Previous knowledge: Students have a little knowledge about the meaning of work, power and energy.

Introduction: The lesson was introduced by asking the whole students of these respected groups, what is the meaning of work?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into 5 different homogeneous academic ability groups. Each subgroup comprised 5 students to allow for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. These would be made possible by using students' basic science achievement results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.

- Step III: - The teacher introduced the activities and emphasized the need for each sub groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;

  i. The use of name when addressing group members;

  ii. Contributions of ideas and suggestions;

  iii. Encouragement of the contribution of ideas verbally and non-verbally;

  iv. Checking understanding of others;

  v. Keeping the group in order;

  vi. Active listening skills;

vii. Summarizing;

viii. Paraphrasing;

ix. Group decision-making;

x. Acknowledge contribution verbally and non-verbally.

- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.

i. Team leader makes certain all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

- Step v:-Each group leader reads out the activity for the group as presented below.

Activity 4: Identifying and discussing on simple machines (wheel and axle).

You are provided with the following equipment in you group; knives, fork, Spoon, axe, hoe, scissor, broom, pliers and a hammer in your group.

.► Carefully examine each of them.

► Your group consist of five students.

► complete the table below or what home tools fit into the arrangement of first, second and third class levers?

Tool	Lever arrangement	Lever class
j- Knives		
k- Fork		
l- Spoon		
m- Axe		
n- Hoe		
o- Scissor		
p- Broom		
q- Pliers		
r- Hammer		

Activity 5: Discussing on the operation of wheel and axle.

You are provided with the following equipment in your group; Rope, Rim of the large wheel, a load.

► Carefully examine each of them.

► The first part is the large wheel of radius R that is also grooved to take a rope..

► When effort is applied by means of a rope attached to the rim of the large wheel, the rope would round the axle of the smaller wheel in the opposite direction raises the load.

► For each complete rotation of the large wheel, there is a complete rotation of the axle.

► Thus, in every complete rotation, the load moves a distance equal to the circumference of the wheel.

► in principle, a load like a bucket of water in a well can be lifted out of the well with effort applied on the rope hanging from the wheel. By pulling on the rope, the bucket of water is lifted from the well.

► All completed recorded activities by each subgroup on the answer sheet are to be collected from subgroup leaders and marked by the researcher.

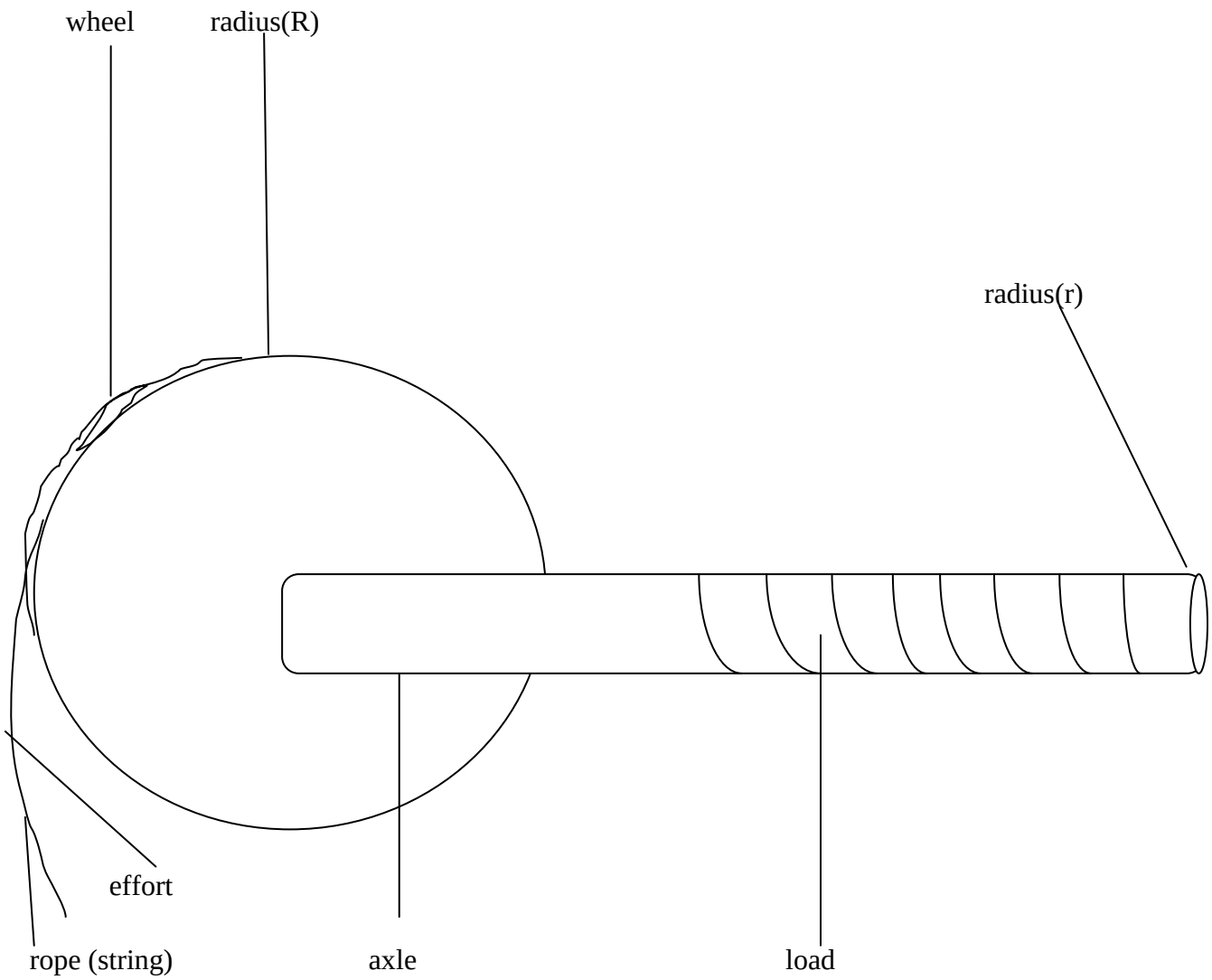


Diagram to show how the wheel and axle works

Evaluation: The teacher asks the students the following questions; e.g

(I) What is simple machine?

(II) List and explain the uses of five simple machines?

(III) What is Levers?

(v) In simple machine what does the wheel and axle means?

(vi) Name one example of wheel and axle and describe how it works.

Conclusion: The teacher concludes the lesson by going round each respected groups and ask them questions about the topic of discussion that is simple machine eg

what is lever and how many class of levers do we have, and correct any mistake done by each group during the group activity. Teacher asks students what is simple machine?, the briefly state and show some part of wheel and axle with their uses in day to day life. Teacher informs students that the next lesson would be on simple machine (screw thread).

Assignment: Students were asked in their respected groups to list examples of parts of simple machines from those once stated during their group lesson.

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan Five

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

Subject: Basic Science

Topic : Simple Machines (Screw thread)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Pencil, Paper and Scissor, Piece of wood, screw driver

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the term screw thread

(II) Identified the part of a screw thread

(III) How to make a paper screw thread

(IV) State one application of the screw thread

(V) Name three examples of a screw thread.

Previous knowledge: Students have already leant about the simple machines wheel and axle.

Introduction: The lesson was introduced by asking the whole students in each of their respected groups, what is screw?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into 5 different homogeneous academic ability groups. Each subgroup comprised 5 subjects to allow for better interaction between the students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. This would be made possible by using students basic science achievement test (BSAT) results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.
- Step III: - The teacher introduced the activities and emphasized the need for each sub groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;
  i. The use of name when addressing group members;
  ii. Contributions of ideas and suggestions;
  iii. Encouragement of the contribution of ideas verbally and non-verbally;
  iv. Checking understanding of others;
  v. Keeping the group in order;
  vi. Active listening skills;
  vii. Summarizing;
  viii. Paraphrasing;
  ix. Group decision making;
  x. Acknowledge contribution verbally and non-verbally.
- Step IV: - Specific roles are given to each member of the group to ensure individual

accountability.

i. team leader makes certain all group members understand roles, instructions and work;

ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

● Step v:-Each group leader reads out the activity for the group as presented below.

Activity 6: Making a paper screw thread.

You are provided with the following materials in your group; pencil, paper and scissors.

► carefully examine each of them.

►your group is made up of five students.

►your group is instructed to Place a pencil on top of a paper and cut the paper into a rectangular equal to the length of the pencil.

► Cut the rectangle into a triangle so that it looks like an inclined plane.

► Wrap the paper around the pencil. What you have is paper screw thread.

► The researcher goes round and help the subjects in each subgroup participate actively.

Activity 7: Demonstrating the use of screws.

In your group, you are provided with the following materials; piece of wood and a screwdriver.

► carefully Examine each of these instrument.

► Hold the screwdriver with your right hand.

► Drill the screwdriver into the wood.

► Record your observation.

► Take the same wood; try to drive a nail into it with your hand.

► Record your experience.

You might have noticed the ease with which the screw moved into the wood.

► Researcher goes round and remain with the subjects to contribute actively for the entire success of their group.

► All completed activities by each subgroup are to be collected from the group leaders and marked by the teacher.

Evaluation: The teacher asks the students the following questions; e.g

(I) Which of these is not a component of a screw?

e. Handle

f. Plane

g. Thread

(II) List the three parts of a screw.

(III) Describe how to make paper screw thread.

Conclusion: The teacher concludes the lesson by briefly explaining to the students briefly the main points in the lesson i.e what is screw, parts of screw and how to make a paper screw thread. Teacher informs the students that the next topic will be on the uses of a screw.

Assignment: The students were told to get a piece of flat wood and make a small hole at centre using the screwdriver.

Lesson Plan for the Experimental Group (Collaborative Learning Strategy)

Lesson Plan Six

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

Subject: Basic Science

Topic : Simple Machines (Gears)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Motorcycle Mechanic's workshop.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Describe gears.

(II) State the application of gears.

Previous knowledge: Students have already learnt about the screw thread, its parts, how it works with their uses.

Introduction: The lesson was introduced by asking the whole students of these respected groups, what are gears in machines?

Lesson Presentation

The lesson was presented as follows;

- Step I:-The students are assigned into 5 different homogeneous academic ability groups. Each subgroup comprised 5 subjects to allow for better interaction between the

students within the group. To ensure homogeneity in academic ability, each group is made up of the same ability level. This was made possible by using students basic science achievement test (BSAT) results.

- Step II: - Each group leader ensures that the students are in their appropriate groups and materials needed for the activity are placed on the table before them.
- Step III: - The teacher introduced the activities and emphasized the need for each sub groups to work collaboratively as a team and what is expected of them to do in the collaborative learning lesson such as;

  i. The use of name when addressing group members;

  ii. Contributions of ideas and suggestions;

  iii. Encouragement of the contribution of ideas verbally and non-verbally;

  iv. Checking understanding of others;

  v. Keeping the group in order;

  vi. Active listening skills;

  vii. Summarizing;

  viii. Paraphrasing;

  ix. Group decision making;

  x. Acknowledge contribution verbally and non-verbally.

- Step IV: - Specific roles are given to each member of the group to ensure individual accountability.

  i. Team leader makes certain all group members understand roles, instructions and work;

  ii. Questioner asks the instructor questions that are posed by the group;

iii. Gate keeper makes sure that everyone participates in the activity;

iv. Group listener gives verbal and non-verbal acknowledgement of contribution of others;

v. Summarizer periodically summarizes the materials so that group members can check it.

● Step v:-Each group leader reads out the activity for the group as presented below.

Activity 8: Describing gears and how the gear works.

In your group, you are taking a trip by your teacher to motorcycle mechanics in order to see how gear works.

► Ask the mechanic to show you a gear.

► Identify the parts of the gear (the driving wheel and the driven wheel).

► Ask the mechanic to show you how the gear works and write it down.

► All completed activities by each subgroup are to be collected from the group leaders and marked by the teacher.

Evaluation: The teacher asks the students the following questions; e.g

(I) A gear transfers energy from the engine to the----------

e. Driving wheel

f. Gear box

g. Toothed wheel

(II) Describe the parts of a gear.

(III) State to applications of gears.

Conclusion: The teacher concludes the lesson by summarizing to the students the main points in the lesson such as how a gear works, finally the teacher informs the

students to read more on uses of gears.

Assignment: Each group were instructed to (1) draw driving and driven wheel. (2) what is the relationship between driving and driven wheel?

Appendix H

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan One ----------

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

Subject: Basic Science

Topic : Work

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Stone of 5kg, wheelbarrow.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the term work

(II) Explain and use the formula in calculating work

(III) Explain the relationship between work and force

(IV) Calculate force using formula

Previous knowledge: Students have a little knowledge about the meaning of work and force.

Introduction: The teacher introduced the lesson by asking the students what is the meaning of work?

Presentation of lesson: The teacher presents the lesson using the following steps;

Step I: The teacher explains the meaning of work to the students, by saying Work is defined as the product of distance moved and the force applied in the direction of movement, and the unit of work is Joules, named after the scientist, P. Joules who carried out early studies on energy.

Step II: The teacher informs the students that the simple formula that can be used to calculate work is:

work = mass × acceleration × distance in the direction of the force.

Step III: The teacher explains to the student that the main relationships between work and force are work is the product of force and distance moved in a given direction, and the quantity of work done is always equal to the quantity of energy put in. in science, work is said to be done when a force can produce movement in a measured direction. While the force changes a body's state of rest or uniform motion in a straight line.

Step IV: The teacher explains to the students that the formula used to calculate force is F = mass (m) × acceleration (a), and the unit of force in Newton (N).

Evaluation: The teacher evaluates the lesson by asking the students the following questions;

(I) What is work?

(II) What work is done when a mass of 5.00kg is raised through a vertical height of 2.5m (acceleration due to gravity is $10m/s^2$)? Used the formula of work to calculate this.

(III) What is the relationship between work and force?

(IV) What is force?

Conclusion: The teacher concludes the lesson by briefly explaining to the students the main points in the lesson i.e what is work and explaining the relationship between work and force. Teacher informs the students that the next topic will be on power.

Assignment: The teacher informs the students to read more about the energy and its sources.

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan Two

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

Subject: Basic Science

Topic : Power

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Load of 3kg, wheel barrow.

Behavioral Objective: By the end of the lesson, students should be able to:

(IV) Define the power

(V) Understanding the relationship between work and power

(VI) Calculating power using formula

Previous knowledge: Students have idea about the work.

Introduction: The teacher introduced the lesson is introduced by asking the students what is the meaning of power?

Lesson Presentation

The teacher presents the lesson using the following steps;

Step I: The teacher explains that power is defined as the rate f doing work, that is work done divided by time.

Step II: The teacher explains to the students that the main relationship between work and power is that power is related to the concepts of energy and work and for any work to be done power must be apply, eg when child fuses an object from one place to another, in this power is applied and work is done.

Step III: The teacher explains how to calculate power by using formula which says

$$\text{Power} = \frac{\text{work done}}{\text{time taken}}$$

Evaluation: The teacher asks the students the following questions; e.g

(I) What is power?

(II) What is the power of a child that has done work of 50J in 10 seconds?

(III) What is the relationship between work and power?

Conclusion: The teacher concludes the lesson by explaining to the students briefly the main points in the lesson i.e what is power and explains how to calculate power using formula which says $\text{Power} = \frac{\text{work done}}{\text{time taken}}$ and also the relationship between work and power.

Teacher informs the students that the next topic will be on energy.

Assignment: The teacher informs the students to give another three relationship between power and work.

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan Three

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

Subject: Basic Science

Topic: Energy

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Load of 1kg, metal balls A, and B,

Behavioral Objective: By the end of the lesson, students should be able to:

(IV) Define the energy

(V) List and explain how they are transfer from one forms of energy to another e.g light to heat energy etc.

(VI) Calculate work, energy and power.

Previous knowledge: Students have already learnt about the work and power.

Introduction: The teacher introduced the lesson by asking the students what is the meaning of energy?

Lesson Presentation

The teacher presents the lesson by using the following steps;

Step I: Teacher explains that energy can be defined as the ability or capacity to do work.

Step II: The teacher lists various forms of energy, which are;

(I) Solar energy

(II) Heat energy

(III) Light energy

(IV) Mechanical energy, which is further divided into two: potential and kinetic energy.

(V) Electrical energy

(VI) Chemical energy

(VII) Sound energy

Step III: The teacher reminds the students about the previous taught formulas for calculating of work, power and energy.

Evaluation: The teacher evaluates the lesson by asking the students the following questions; e.g

(I) What is energy?

(II) Suppose a ball of mass 1kg falls from a height 2m to the ground. Calculate the potential energy and kinetic energy of the ball?

(III) Boys were instructed to lift up a body of mass of 1kg the load through a height of 1m, how much work is done?

Conclusion: The teacher concludes the lesson by explaining to the students briefly the main points in the lesson i.e what is energy and explain different forms of energy. Calculate power-using formula, which says Power $= \frac{\text{work done}}{\text{time taken}}$

and work done = mass × distance,

where kinetic energy = mass × acceleration due to gravity × distance.

Teacher informs the students that the next topic will be on simple machines (wheel and axle).

Assignment: The teacher informs the students to how loads are carrying in a wheelbarrow from one place to another.

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan Four

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

Subject: Basic Science

Topic : Simple Machine (Wheel and Axle)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Knives, Fork, Spoon, Axe, Hoe, Scissors, Tin-cutter, Broom, Pliers, Hammer, Rope, Rim of the large wheel, a load.

Behavioral Objective: By the end of the lesson, students should be able to:

(VI) Explain the meaning of Simple Machines with its examples

(VII) Explain the Meaning of Levers with its three classes.

(IV) Explain the meaning of wheel and axle with its examples

(V) Demonstrate the operation of wheel and axle, with their uses

Previous knowledge: Students have learnt about the meaning of work, power and energy.

Introduction: The teacher introduced the lesson by asking the students what is the meaning of work?

Lesson Presentation

The teacher presents the lesson using the following steps;

Step I: Teacher explains that simple machine is a device which uses a force applied at one point called effort to overcome another force called load at some other point. A simple machine enables a large load to be overcome by a small effort. In other words, a machine makes it possible for us to do work more easily. Examples of simple machines include the following; Screw driver, Hammer, Scissors, pliers, wheelbarrow, Knives, fork, Spoon, Broom and Hoe.

Step II: The teacher further explains to the students that collections of simple machines are called levers.

Step III: The teacher explains to the students that the lever is the simplest form of simple machines. It is rigid bar that has effort, load and fulcrum or pivot fixed at various positions. The lever is of three classes, defending on the relative positions of the effort, load and fulcrum. These three classes of levers are as follows;

(I) First class levers: the fulcrum or pivot is between the effort and load.

(II) Second class lever: the load is between the fulcrum and the effort.

(III) Third class lever: the effort is between the load and the fulcrum.

Step IV: The teacher explains to the students that, the wheel and axle is a form of simple machine made of two wheels of different diameters that are rigidly fixed on the same axle. The axle is the cylindrical rod that joins two wheels together. As the axle revolves, the wheels revolve automatically. Wheel and axles are made in a variety of forms. The common example is the windlass used to raise bucket from the wells. The screwdriver and the steering wheel of a motorcar are other example of a wheel and axle.

Evaluation: The teacher evaluates the lesson by asking students the following questions;

(I) What is simple machine?

(II) List and explain the uses of five simple machines?

(III) What is Levers?

(IV) In simple machine what does the wheel and axle means?

(V) Drawing water using bucket from deep well.

Conclusion: The teacher concludes the lesson by asking the students the following questions about the topic of discussion, that is simple machine e.g. what is lever and how many classes of levers do we have, and at the end the teacher informs the students that the next topic will also be on simple machine but in the part of operation of wheel and axle and the uses of the wheel and axle.

Assignment: Students were asked to list more examples of parts of simple machines from those stated in this lesson.

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan Five

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

Subject: Basic Science

Topic: Simple Machines (Screw thread)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Pencil, Paper, Scissor and Piece of wood, screwdriver

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Define the term screw thread

(II) Identified the part of a screw thread and make a paper screw thread.

(III) State the application of the screw thread.

(IV) Name three examples of a screw thread.

(V) Demonstrating the use of screws.

Previous knowledge: Students have already leant about the simple machines i.e wheel and axle.

Introduction: The teacher introduced the lesson by asking the students, what is screw?

Lesson Presentation

The teacher presents the lesson using the following steps;

Step I: The teacher explains to the students that screw can be described as an inclined plane wrapped round a cylinder in form of a thread. It is also a machine. As a machine, it does a tremendous amount of work for small amount of effort. Examples of screws include the carpenters screw, bolts and nuts, and the car jack.

Step II: In terms of parts of screw, the teacher further stated that a simple screw consists of rod, which has a thread. The distance between two threads is called the Pitch (h) of the screw; the handle of the screw is called the Effort. It is the point of rotation or the point at which effort is applied.

Step III: The teacher shows the students that when making a paper screw the procedure are as follows;

(I) Place a pencil on top of a paper and cut the paper into a rectangle equal to the length of the pencil.

(II) Cut the rectangle into a triangle so that it looks like an inclined plane.

Step IV: The teacher explains that screws are used daily for the purpose of holding different parts of objects together with considerable ease. You would have seen a motor mechanic driving a screw into car components or a carpenter trying to drive a screw into a hard piece of wood, instead of trying to push a nail into it. Screw is used in making holes in hard materials such as wood and soft iron.

Step III: The teacher demonstrates the use of screws as follows;

(I) The teacher brings out a piece of wood and a screwdriver to the students.

(II) The teacher holds the screwdriver with his right hand.

(III) The teacher drills the screwdriver into the wood.

(IV) The teacher together with students record the observation.

(V) He shows again to the students by taking the same wood, try to drive a nail into it with his hand.

(VI) The teacher together with students record the observation.

You might have noticed the ease with which the screw moved into the wood.

Evaluation: The teacher asks the students the following questions; e.g

(IV) Which of these is not a component of a screw?

h. Handle

i. Plane

j. Thread

(V) Describe a screw thread.

(VI) Describe how to make a paper screw thread.

Conclusion: The teacher concludes the lesson by explaining to the students briefly the main points in the lesson i.e what is screw, explain parts of a screw and how to make a paper screw thread. Teacher informs the students that the next topic would be on simple machines (gears).

Assignment: The students were told by the teacher to get a piece of plat wood and make a small hole at centre using the screwdriver.

Lesson Plan for the Control Group (Lecture Method)

Lesson Plan Six

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

Subject: Basic Science

Topic: Simple Machines (Gears)

Class and students category: JSS II Low ability students

Date: ----------

No of Students in Class: 30 Students

Time: Double period (1 Hour)

Sex of students: ----------

Average age of Students: 13-14 years

Instructional Materials: Driving wheel and Driven wheel.

Behavioral Objective: By the end of the lesson, students should be able to:

(I) Describe gears.

(II) State the application of gears.

(III) How the gear works.

Previous knowledge: Students have already learnt about the screw thread, its parts, how it works with their uses.

Introduction: The teacher introduced the lesson by asking the students, what are gears in machines?

Lesson Presentation

The lesson was presented using the following steps;

Step I: The teacher explains that one of the forms of simple machines is a gear. The gear is a machine, which allows work to be done easily. If the car has no gear, the car cannot move and we may be left to always push our cars before we can move. As a machine, the gear helps to transfer energy from the engine of a car or vehicle to the driving wheel. The principle of gear is similar to that of a screw. The gearbox has some kind of threads and pitches just like the screw. Gears are made up of two wheels that have teeth. One wheel called the driving wheel drives the other wheel called the driven wheel. The teeth of the two wheels are made to interlock such that on the application of effort on the driving wheel, the driven wheel rotates simultaneously and the vehicle moves.

Step II: In terms of the application of gears, the teacher stated them as follows;

(I) What a gear does is to transfer the energy from the engine to the driving wheel of a vehicle in order to make the wheel to rotate, thereby making the vehicle to move.

(II) When a vehicle is already moving, changing a gear helps to change the fulcrum of the moving vehicle, making it to move faster, more efficiently and powerful in climbing a hill or in making it run normally.

(III) Gears make it easier for a vehicle to overcome resistance against motion.

(IV) The gear makes a crushing machine more powerful in crushing hard objects.

Step III: The teacher shows and explains the procedure on how the gear works as follows;

(I) The teacher takes students to a motorcycle mechanic's workshop.

(II) The teacher together with students ask the mechanic to show you a gear.

(III) They all identify the parts of the gear (the driving wheel and the driven wheel)

(IV) They asks the mechanic to show you how the gear works.

(V) Students write note on gears.

Evaluation: The teacher ask the students the following questions; e.g

(IV) A gear transfers energy from the engine to the----------

h. Driving wheel

i. Gear box

j. Toothed wheel

(V) Describe the parts of a gear.

(VI) State one application of gear in machine.

Conclusion: The teacher concludes the lesson by summarizing to the students the main points of the lesson such as how a gear works, finally the teacher informs the students to read more on uses of gears.

Assignment: Students were asked after this lesson, to take a trip to a motorcar or motorcar

mechanic's workshop, and ask the mechanic to show you a gear, identify the parts of the gear (the driving wheel and driven wheel), and ask the mechanic to show them how the gear works, and write your own group note on gears.

Appendix I Item Difficulty Index and Discrimination Index

S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	24
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DI	**60**	**53**	**53**	**55**	**65**	**50**	**58**	**45**	**53**	**45**	**50**	**50**	**45**	**45**	**53**	**60**	**40**	**55**	**45**	**43**	**45**	**48**	**50**	**50**	**50**	
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DI ITEM DIFFICULTY

ID ITEM DISCRIMINATION

DEPARTMENT OF SCIENCE EDUCATION

AHMADU BELLO UNIVERSITY ZARIA

Vice Chancellor: ***Professor Abdullahi Mustapha*** *B.Sc(Hons)Pharm(ABU), Ph.D(London) FPSN*
Head of Department: ***Dr. Mamman Musa*** *B.Ed, M.Ed, Ph.D (ABU, FMAN, FANE, DAC.*

Your Ref:

Our Ref: DSE/R/I/Vol.1

Date: 13TH JANUARY 2014

THE COMMISSIONER
MINISTRY OF EDUCATION
KANO STATE
NIGERIA

Dear Sir/Madam,

AN INTRODUCTORY LETTER TO ACCESS RESEARCH DATA

This is to introduce the bearer, UMAR ISHAQ, with registration number MED/EDU/675/11-12, who is one of our M.Ed Science Education students conducting a research on the topic: EFFECT OF COLLABORATIVE LEARNING STRATEGY ON ACADEMIC ACHIEVEMENT AMONG JUNIOR SECONDARY SCHOOL TWO STUDENTS OF LOW ABILITY IN FAGGE LOCAL EDUCATION AUTHORITY OF KANO STATE

Please accord him/her all the necessary assistance needed as a fulcrum for useful contribution of his/her quota to knowledge.

Yours faithfully,

H.O.D.
SCIENCE EDUCATION
A.B.U. ZARIA.

Dr. Mamman Musa
Head, Science Education Department

Appendix K

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD

GIDAN MALAMAI

No. 1 Lawan Danbazau Link behind Bank of the North Headquarters, Kano.

☎ : 064-318855, 669420, 661948, 667884, 667869

Our Ref: _____ Your Ref: _____ Date 8TH MAY, 2014

The Zonal Education Officer,

NASSARAWA Zonal

Education Office KANO.

LETTER OF INTRODUCTION

The bearer of this letter is a researcher from AHMADU BELLO UNIVERSITY

He is conducting a research on EFFECT OF COOPERATIVE LEARNING STRATEGY ON ACHIEVEMENT IN BASIC SCIENCE AMONG J.SS II OF LOW ABILITY in your zone. You are expected to give him/her all the necessary assistance to facilitate his research because of the importance the Board attaches to research work.

The Board appreciates your usual co-operation.

Best regards.

Shuaibu Kassim Abubakar
CEO – Publication/Documentation
For *Director General*

Appendix L

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD
DEPARTMENT OF PLANNING,RESEARCH AND STATISTICS
PUBLIC SCHOOLS IN FAGGE LGA AS AT JANUARY,2014

S/NO	SCHOOL NAME	JSS 1	JSS 2	JSS 3	SS 1	SS 2	SS 3	TOTAL
1	ADSS BUKAVU BOYS	540	540	420	480	540	810	3,330
2	ADSS BUKAVU GIRLS	356	288	573	393	421	416	2,447
3	GASS KWACHIRI	306	368	221	348	201	280	1,724
4	GC KANO (KTC)	420	460	336	420	547	404	2,587
5	GGASS MASALLACHI	180	153	67	84	136	77	697
6	GGASS TUDUN BOJUWA	640	660	596	501	501	396	3,294
7	GGJSS DANRIMI	340	229	331	0	0	0	900
8	GGSS AISHA SHEHU	180	180	120	165	0	0	645
9	GGSS DABO	300	325	200	287	314	224	1,650
10	GGSS MAIKWATASHI	480	360	360	600	480	420	2,700
11	GGSS MARYAM ABACHA	300	240	230	120	180	180	1,250
12	GJSS DABO	180	180	207	0	0	0	567
13	GJSS DAN-WAIRE(CO-EXIST)	176	88	103	0	0	0	367
14	GJSS NATSUGUNE	120	166	63	0	0	0	349
15	GJSS NOMANSLAND(CO-EXIST)	190	141	53	0	0	0	384
16	GJSS TUDUN BOJUWA	240	360	503	0	0	0	1,103
17	GJSS WAPA	120	68	71	0	0	0	259
18	GJSS ZAWA'I(CO-EXIST)	187	172	78	0	0	0	437
19	GSCS AIRPORT ROAD	480	433	431	480	466	433	2,723
20	GSS DARERAWA	240	240	306	207	217	0	1,210
21	GSS GOGAU	120	148	86	100	0	0	454
22	GSS KWAKWACHI	343	170	229	211	294	339	1,586
23	GSS MAIKWATASHI	240	198	200	476	440	508	2,062
24	GSS MVA KUKA	180	240	266	298	458	361	1,803
25	GSS STADIUM	360	311	353	335	360	561	2,280
	Grand Total	7,218	6,718	6,403	5,505	5,555	5,409	36,808

DIRECTOR
PLANNING RES. & STATISTIC
KANO STATE
SEN. SEC. SCH. MGT

Appendix M

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA

P.M.B 3398, KANO

Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 8th May, 2014.

The Principal,
GGSS Maryam Abacha,
Katsina Road,
Kano.

INTRODUCTION LETTER

I am directed to introduce LIMAN MUSHAQ from the Department of SCIENCE EDUCATION Ahmadu Bello University Zaria/BUK. He is Conducting a research titled EFFECTS OF COOPERATIVE LEARNING STRATEGY ON ACADEMIC ACHIEVEMENT IN BASIC SCIENCE IN JSS in some selected Senior Secondary Schools in Kano State.

The Board expects you to give him all the necessary assistance during the research. Your usual cooperation is highly appreciated by the Board.

Best regards.

ADAMA KABIR MUHAMMAD
ASST. ZONAL EDUC. OFFICER

Appendix N

KANO STATE SENIOR SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA

P.M.B 3398, KANO

Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 8th May, 2014.

The Principal,
GJSS Gogau,
Katsina Road,
Kano.

INTRODUCTION LETTER

I am directed to introduce LIMAN ISHAQ from the Department of SCIENCE EDUCATION Ahmadu Bello University Zaria/BUK. He is Conducting a research titled EFFECTS OF COOPERATIVE LEARNING STRATEGY ON ACADEMIC ACHIEVEMENT INTEREST IN SCIENCE AMONG JSS in some selected Senior Secondary Schools in Kano State.

The Board expects you to give him all the necessary assistance during the research. Your usual cooperation is highly appreciated by the Board.

Best regards.

ASST. ZON. EDU. OFFICER
NASSARAWA ZONE KSSSMB
8/5/14

ADAMA KABIR MUHAMMAD
ASST. ZONAL EDUC. OFFICER

Appendix O

KANO STATE SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA
P.M.B 3398, KANO

Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 08Th Jan. 2015.

The Principal,
GHSS Dan Kimi

INTRODUCTION LETTER

I am directed to introduce Umar Ishaq MED/EDUC/675/11-12 a researcher from ABU Zaria. He is conducting a research on "Effect of collaborative learning on achievement in Basic Science among Junior Secondary Schools students of law ability in kano metropolis, Nigeria."

The Board expects you to give him all the necessary assistance during the research. Your usual cooperation is highly appreciated.

Best regards.

ASST ZONAL EDU OFFICER
NASSARAWA ZONE KSSSMB
DATE 8/1/2015 SIGN

SERVICE TO HUMANITY

ALI MUHAMMAD YAKASAI
A. Z. E. O.
FOR: ZONAL EDUC. OFFICER

Appendix P

KANO STATE SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA
P.M.B 3398, KANO

Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 08Th Jan. 2015.

The Principal,
GJSS Dabo

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FOR: ZONAL EDUC. OFFICER

Appendix Q

KANO STATE SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA
P.M.B 3398, KANO

Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 08Th Jan. 2015

The Principal,
GASS Kisachiki

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ASST ZONAL EDU OFFICER
NASSARAWA ZONE KANO
DATE 8/1/15 SIGN

SERVICE TO HUMANITY

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A. Z. E. O.
FOR: ZONAL EDUC. OFFICER

Appendix R

KANO STATE SECONDARY SCHOOLS MANAGEMENT BOARD

ZONAL EDUCATION OFFICE, NASSARAWA
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Our Ref: NZEO/ADM/5 Your Ref: _____ Date: 08Th Jan, 2015

The Principal,
GGASS Masallachi
Fagge

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ALI MUHAMMAD YAKASAI
A. Z. E. O.
FOR: ZONAL EDUC. OFFICER