

**TEACHERS' COGNITIVE QUESTIONING STYLES AND THEIR  
EFFECTS ON ACADEMIC ACHIEVEMENT OF JUNIOR  
SECONDARY SCHOOL STUDENTS IN INTEGRATED SCIENCE IN  
GIWA INSPECTORATE DIVISION**

***BY***

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**MAY, 2011**

## **DECLARATION**

I hereby declare that this thesis titled, “Teachers’ Cognitive Questioning Styles and their Effects on Academic Achievement of Junior Secondary School Integrated Science Students” has been written by me. It is a result of my own research work and it has not been presented in any previous application for a higher degree. All quotations and sources of information are fully acknowledged by means of references.

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Date

## CERTIFICATION

This thesis titled “Teachers’ Cognitive Questioning Styles and their Effects on Academic Achievement of Junior Secondary School Integrated Science Students in Giwa Inspectorate Division” by ILIYA Binta Shika meets the requirements governing the award of Master Degree in Science Education (Int. Science) of Ahmadu Bello University, Zaria and is approved for its, contribution to knowledge and literary presentation.

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## **DEDICATION**

This work is dedicated to my late mother Malama Hadiza Abdullahi Iliya and my father Alhaji Iliya ‘Yankusa.

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## ABSTRACT

This study investigated the effects of teachers' cognitive questioning styles on academic achievement of Junior Secondary School Students in Integrated Science. A quasi-experimental pretest, posttest and post-posttest research design was used for the study which featured two groups of integrated science students. One hundred JSS II students randomly selected from two schools in Giwa Inspectorate Division of Kaduna State formed the study sample. They were taught integrated science concepts using low-level and high-level cognitive questioning styles. Performance of the two groups were compared using their posttest and post-posttest mean scores. Four null hypotheses were tested using t-test statistics at a significance level of  $P \leq 0.05$ . Integrated Science Achievement Test (ISAT) with reliability coefficients of 0.85, was used to collect data for the study. The following findings were obtained from the study: (i) There was no significant difference in the mean scores of students taught using low-level and high-level cognitive questioning styles. (ii) Male students performed significantly better than female students when taught using low-level cognitive questioning styles. (iii) There was no significant difference when male and female students were taught using high-level cognitive questioning styles. (iv) There was significant difference in the mean scores of students retention ability when taught using low-level and high-level cognitive questioning styles, in favour of those exposed to high-level questioning styles. Based on the above findings, recommendations were made among which are the need for Integrated Science teachers to endeavour to use both low-level and high-level cognitive questioning styles in the teaching and learning of Integrated Science.

## TABLE OF CONTENTS

Title Page	-	-	-	-	-	-	-	-	-	-	page
Declaration	-	-	--	-	-	-	-	-	-	-	ii
Certification	-	-	-	-	-	-	-	-	-	-	iii
Dedication	-	-	-	-	-	-	-	-	-	-	iv
Acknowledgement	-	-	-	-	-	-	-	-	-	-	v
Abstract	-	-	-	-	-	-	-	-	-	-	vi
Table of Contents	-	-	-	-	-	-	-	-	-	-	vii
Abbreviations Used	-	-	-	-	-	-	-	-	-	-	x
Operational Definition of Terms	-	-	-	-	-	-	-	-	-	-	xi
List of Tables	-	-	-	-	-	-	-	-	-	-	xii
List of Figures	-	-	-	-	-	-	-	-	-	-	xiii
List of Appendices	-	-	-	-	-	-	-	-	-	-	xiv
<b>Chapter One: THE PROBLEM</b>											
1.1	Introduction	-	-	-	-	-	-	-	-	-	
1.2	Statement of the Problem	-	-	-	-	-	-	-	-	-	4
1.3	Objectives of the Study-	-	-	-	-	-	-	-	-	-	5
1.4	Research Questions	-	-	-	-	-	-	-	-	-	6
1.5	Null Hypotheses	-	-	-	-	-	-	-	-	-	6
1.6	Significance of the Study	-	-	-	-	-	-	-	-	-	7
1.7	Delimitation of the Study	-	-	-	-	-	-	-	-	-	8
<b>Chapter Two: REVIEW OF LITERATURE</b>											
2.1	Introduction	-	-	-	-	-	-	-	-	-	
2.2	The Concept, Philosophy and Objectives of Integrated Science	-	-	-	-	-	-	-	-	-	9
2.3	Description of Cognitive Domain	-	-	-	-	-	-	-	-	-	11
2.4	Cognitive Questioning Styles	-	-	-	-	-	-	-	-	-	13
2.4.1	Low-level Cognitive Questioning Styles-	-	-	-	-	-	-	-	-	-	14
2.4.2	High-level Cognitive Questioning Styles	-	-	-	-	-	-	-	-	-	14
2.5	Cognitive Questioning Styles and Academic Achievement in Science	-	-	-	-	-	-	-	-	-	15

	page
2.6 Cognitive Questioning Styles and Retention - - - -	17
2.7 Gender, Cognitive Questioning Styles and Academic Achievement in Science - - - - -	16
2.8 Similar Studies on Cognitive Questioning Styles and Academic Achievement in Science - - - -	19
2.9 Implications of the Literature Reviewed on the Present Study - - - - -	21
<b>Chapter Three: METHODOLOGY</b>	
3.1 Introduction - - - - -	
3.2 Research Design - - - - -	22
3.3 Population of the Study - - - - -	23
3.4 Sample and Sampling Procedure - - - - -	25
3.5 Instrumentation - - - - -	26
3.5.1 Validity of the Instrument - - - - -	26
3.6 Pilot Study - - - - -	27
3.6.1 Reliability of the Instrument - - - - -	27
3.6.2 Item Analysis of ISAT - - - - -	27
3.6.3 Selection of Content Taught in the Study - - - - -	28
3.7 Administration of Treatment - - - - -	29
3.8 Data Collection Procedure - - - - -	29
3.9 Data Analysis Technique - - - - -	30
<b>Chapter Four: ANALYSIS, RESULTS AND DISCUSSION</b>	
4.1 Introduction - - - - -	
4.2 Data Analysis - - - - -	31
4.4 Summary of Findings. - - - - -	34
4.5 Discussion of Results - - - - -	34
<b>Chapter Five: SUMMARY, CONCLUSION AND RECOMMENDATIONS</b>	
5.1 Introduction - - - - -	
5.2 Summary - - - - -	37
5.3 Major Findings -- - - - -	38

										page
5.4	Conclusions	-	-	-	--	-	-	-	-	38
5.5	Recommendations	-	-	-	-	-	-	-	-	39
5.6	Limitations of the Study	-	-	-	-	-	-	-	-	38
5.7	Suggestions for Further Studies	-	-	-	-	-	-	-	-	40
	References	-	-	-	-	-	-	-	-	41
	Appendices	-	-	-	-	-	-	-	-	46

## **ABBREVIATIONS USED**

The following abbreviations are used in the study:

FME	Federal Ministry of Education
WAEC	West African Examination Council
JSS	Junior Secondary School
JSCE	Junior Secondary Certificate Examination
ISAT	Integrated Science Achievement Test
GJSS	Government Junior Secondary School
YASS	Yusuf Aboki Secondary School
GSS	Government Secondary School
Dr. S.L.G.G.S.S	Dr Shehu Lawal Giwa Girls Secondary School
ERC	Educational Resource Centre
NISTEP	Nigeria Integrated Science Teacher Education Project
NISP	Nigeria Integrated Science Project

## OPERATIONAL DEFINITIONS OF TERMS USED IN THE STUDY

<b>Cognitive Domain -</b>	Refers to objectives that dealt with the recall or recognition of knowledge and the development of intellectual abilities and skills.
<b>Low –Level Cognitive Questioning Styles -</b>	Refer to questions that require students to recall material easily from what they are taught. They include questions that can be answered with yes or no, a single word or a short phrase.
<b>High –Level Cognitive Questioning Styles-</b>	Refer to those questions that require students to mentally manipulate information they have learned and to answer with reasoned evidence.
<b>Academic Achievement -</b>	Is the assessment of how much students have learnt or attained after a learning period.
<b>Retention</b>	The ability to remember and consequently recall things experienced or learnt by an individual at a later time.

## LIST OF TABLES

		page
Table 3.1	Population of the Study. - - - -	22
Table 3.2	Sample of the Study. - - - -	23
Table 4.1	Summary of t-test Analysis of the Mean Scores of Students Exposed to Low-level and High-Level Cognitive Questioning Styles in Integrated Science. - -	30
Table 4.2	Summary of t-test Analysis of the Mean Scores of Male and Female Students Exposed to Low-Level Cognitive Questioning Style in Integrated Science. - - - -	30
Table 4.3	Summary of t-test Analysis of the Mean Scores of Male and Female Students Exposed to High-Level Cognitive Questioning Style in Integrated Science. - - - -	31
Table 4.4	Summary of t-test Analysis of the Mean Scores of Student Exposed to Low-Level and High-Level Cognitive Questioning Styles on Retention Ability in Integrated Science. - -	31

**LIST OF FIGURE**

<b>FIGURE I</b>		<b>page</b>
Research Design Illustrated.	- - - - -	21

## LIST OF APPENDICES

<b>Appendix</b>		<b>Page</b>
A.	Students integrated science achievement test (ISAT)-	45
B.	Integrated Science Achievement Test (ISAT)	
	Objective answer Sheet - - - - -	52
C.	Marking Scheme for ISAT - - - - -	53
D.	Low-Level Questions Lesson Plan - - - - -	54
E.	High – Level Questions Lesson Plan- - - - -	72
F.	Table of Specification for Item Distribution - - - - -	91
G.	Table of Specification for Content Taught in the Study - - - - -	92
H.	Farmula for Facility Indices (FI) - - - - -	93
I.	Formula for Discrimination Indices (DI) - - - - -	94
J.	Reliability of the Instrument - - - - -	95

## **CHAPTER ONE**

### **THE PROBLEM**

#### **1.1 Introduction**

For over five decades, a number of efforts have been made nationally and internationally to improve the teaching and learning of science in schools. This has been a subject of considerable concern in Nigeria. The central concern has been to make the teaching and learning of science in the classroom more meaningful and more effective in order to achieve the educational goals of the society.

Effective science teaching involves student's active participation in the teaching-learning process, more especially as it involves asking and answering questions. Lack of active participation of students has been described as one of the factors responsible for poor academic performances in science subjects (Inyang, 1988, Bichi, 1988, Mari, 1994 and Usman, 2001). It has also been indicated in WAEC chief examiners report (2004) results of secondary schools where students performances are generally poor in Biology, Chemistry, Physics and other science related subjects. They perform poorly in questions that require high-level cognitive domain (Winne, 2007). The reason why students perform poorly in questions at high level cognitive domain could be that teachers frequently ask questions that are low in cognitive domain. Therefore the aim of enhancing student's academic achievement will not be realized if questions asked by teachers are not in conformity with demands of all the levels of Bloom's taxonomy of educational objectives (cognitive domain).

Integrated science was introduced as a foundation to the science courses as well as to promote scientific literacy amongst the Nigeria youths; this is introduced at the lower level of education. It is supposed to give the students the basic scientific knowledge they need as well as to equip them to be scientifically literate. This is because most of the students terminate their science learning at the junior secondary school level.

Integrated science as defined by Olanrewaju (1983) is an approach to science in which concepts and principles are presented so as to express the functional unity of scientific thought. The aim of integrated science programme as stated by Usman (2001) is to enable students achieve the process and product content of integrated science. The National Policy on Education (FME, 2004) include integrated science as a core subject at

the junior secondary school level in its curriculum. Integrated science emphasizes the teaching and learning processes which lead to fundamental foundation in the sciences at all levels of education.

Low academic achievement of students in the sciences, integrated science inclusive, has been a growing concern in the school. To this effect, scholars have carried out studies to investigate the factors that may be responsible. Some of these factors have been linked to the non-availability of teaching materials, lack of adequate laboratory and its facilities, and the methods of teaching used by the teachers among others (Usman, 2007 and 2008).

For students to achieve high in science, the teacher has to use a strategy which will enable the students to understand science concepts and create conducive environment that will change effective teacher-student interaction. The teacher must know the extent to which students have knowledge of a learning task. This is a prerequisite for effective teaching (Bloom, 1981, Hargreaves, 1984). The student unfortunately is not a transparent box through which the teacher can see and read the amount of knowledge that has been or is being acquired. The teacher should be able to assess the student's understanding of science concept through questioning based on his experiences in teaching/learning outcome in accordance with Bloom's taxonomy of cognitive domain. The age-old technique made famous by Socrates and practiced by classroom teachers has been the use of questions to aid students in developing ideas and conclusions and drawing their own inferences. Therefore a question is a direction to a learner to examine instructional materials or his memory of it and to produce some response (Redfield and Rouseau, 1981, Gandu, 2006).

The cognitive level of a question refers to the nature of cognitive processes required to answer it. There are two broad types of cognitive question styles which are the low-level and high level cognitive questions styles. Low-level questions are called knowledge questions that require students to recall material easily from what they are taught (Cotton, 2001). According to her, low-level questions help students to remember factual information, study for test previously read or presented by a teacher. They are designed to solicit from students' concept, information, feeling or experiences that were gained in the past and stored in the memory. They also include questions that can be

answered with yes or no, a single word or a short phrase. Sample key words are; complete, define, count, identify, list, name, recall, recite, observe, what, when, where among others. Low-level cognitive questions according to (Callahan and Clark, 1988; Gandu 2006) do not challenge the students' ability to think, but only to remember. They are used to reinforce learning and to check on students' retention of what is learnt.

High-level cognitive questions are those requiring students to mentally manipulate information they have learned and to answer with reasoned evidence (Brualdi, 1998). They are also called open-ended, interpretative, evaluative, inquiry, inferential and synthesis questions that require skills. By using these skills, students do not remember only factual knowledge, instead they use their knowledge to solve a problem, to think intuitively, creatively, hypothetically, to analyze, to use their imagination, to expose a value system, to make judgment and to evaluate (Derfel, 2002). According to him, it is believed that high-level cognitive question style reveals whether or not a student has grasped a concept taught. This is because a student needs to have a deep understanding of the topic in order to answer this type of question, that is high-level cognitive question. Sample key words, for high-level cognitive questions are: apply a principle, predict, manipulate, generalize, hypothesize, judge, evaluate.

Various authors Brualdi, (1998) Cotton, (2001) Susan, (2001) have described the impact of cognitive question styles on academic achievement of students as it developed interest and motivate students to become actively involved in lessons. It also helps in assessing students achievement of instructional goals and objectives. Arends (1994) argues that many of the findings concerning the effects of using low-level cognitive versus high-level cognitive questions have been inconclusive at secondary school level. While some studies and popular belief favor asking high-level cognitive question, other studies reveal the positive effect of asking low-level cognitive questions (Brualdi, 1998, Gandu, 2006). Therefore based on the findings of the studies above using low-level and high-level cognitive questioning styles, there is the need to investigate the effect of teachers cognitive question styles on academic achievement of students in integrated science.

In Nigeria and many other countries, women are grossly under-represented in scientific and technological fields. Science educators have carried out a number of studies

on gender differences and science learning, and they revealed the under-representation of girls in science, mathematics and technical subjects at secondary school level (Yoloye, 1994, Fakorede, 1999, Okeke, 2001). A good number of researchers showed that poor performances in science are well pronounced among female students (Abah, 1991, Iliya, 2001). Some reasons have been advanced for the differences in academic achievement between males and females. Some of these differences have been linked to the way science is being taught in the classroom (Ibeme, 1975, Okeke 2001).

Gender inequality in education has a variety of negative consequences for the women affected and for the scientific community at large. At the most basic level, the gender gap threatens to turn research science into a “closed club” where consensus thinking and the absence of new perspectives may hinder advances (Microsoft Encarta Reference Library 2005). Women who lack the opportunity to discover their scientific aptitudes may end up in careers to which they are less suited, and even female students with no scientific aspirations might suffer without the rounded educational experience granted to their male peers. The issue of gender is still a controversy and therefore this study investigated gender related effect of low-level and high-level cognitive questions asked by teachers on academic achievement of male and female students in integrated science.

Retention is the ability to retain and later remember information or knowledge gained after learning (Bichi, 2002). It takes place when learning is coded into memory. Thus appropriate coding of incoming information provides the index that may be consulted to that retention. Materials are related to quality of retention in terms of their meaningfulness, familiarity, concreteness and image evolving characteristics (Adeniyi, 1997). Another variable of importance that was investigated in this study is the retention ability of students, when exposed to low-level and high-level cognitive questioning styles.

## **1.2 Statement of the Problem**

The need for effective science teaching and learning in our schools are means of achieving the much needed technological breakthrough in the country is widely recognized and accepted by all. In spite of this recognition, performance in science

esubjects continues to be poor. (Usman, 2007; Gandu, 2006) found out in their separate studies that there is a decline in students' achievement in integrated science. This decline has been linked to the way the integrated science teachers teach in the classroom among other reasons (Usman, 2008).

The extent to which learners acquire knowledge and skills can be determined through the use of questions. The response of the students to a question will show how much they know or does not know. Hence questions are an important variable in learning (Gall, 1970; Gandu, 2006). Teachers use question for many purposes like evaluating students learning, checking their class work and homework, reviewing and summarizing lessons (Cotton, 2001). In addition, teachers ask students questions to motivate them to learn, to develop their thinking skills and stimulate students to inquire on their own (Cotton, 2001).

Many researchers (Brualdi, 1998; Cotton 2001), Susan 2001) have addressed themselves to the issue of the extent to which cognitive level of teachers' question are important variables in students' achievement. The effect of question styles on students' academic achievement suggested that higher order questions which require thought rather than memory increase students achievement in science at secondary school level (Susan, 2001). Teachers spend most of their time asking low-level cognitive question (willen, 1991). These questions concentrate on factual information that can be memorized for example (where is the fire extinguisher located in the laboratory) it is believed that this type of question can limit students by not helping them to acquire a deep understanding of the subject matter (Brualdi, 1998). Thus resulting to the students' poor academic achievement in science among secondary school students (Gandu, 2006). This study is needed in our secondary schools because there is consistent failure in integrated science at junior secondary schools level. This may be due to lack of practical work, use of lecture method and teachers' questioning technique among others. (Inyang 1988, Mari 1993, Usman 2000; Gandu, 2006). The aspect of teachers' cognitive question style was investigated in order to recommend appropriate cognitive questioning style that may enhance students' achievement in integrated science. Therefore there is the need to find out whether teachers questioning styles affect students' academic achievement and retention ability in integrated science at junior secondary school level or not. Specifically

the concern of this study is to investigate teachers cognitive questioning styles and their effects on academic achievement and retention of junior secondary school students in integrated science.

### 1.3 Objectives of the Study

This research is aimed at investigating the effect of the use of low-level and high-level cognitive questions in integrated science at the junior secondary school level. The objectives of the study are to determine:

- the effects of low-level and high-level cognitive questions on academic achievement of students in integrated science at the junior secondary school level.
- whether male and female students exposed to low-level cognitive questions differ in academic achievement in integrated science. That is, whether or not low-level cognitive question style is gender-related.
- the effect of high-level cognitive questions among male and female students in academic achievement in integrated science at junior secondary school level. That is whether high-level cognitive question style is gender-related or not.
- the effect of low-level and high-level cognitive questioning styles on retention ability of students in integrated science at JSS level.

### 1.4 Research Questions

Based on the problem stated above, the research sought answers to the following questions:

1. Do students exposed to low-level cognitive questions differ in their academic achievement scores in integrated science as compared with those exposed to high-level cognitive questions?
2. Do male students exposed to low-level cognitive questions differ in academic achievement scores in integrated science as compared with female students exposed to low-level cognitive questions?
3. Do male students exposed to high-level cognitive questions differ in their academic achievement scores in integrated science as compared with female students exposed to high-level cognitive questions?

4. Do students exposed to low-level cognitive questioning styles differ in retention ability in integrated science as compared with those exposed to high-level cognitive questioning styles?

### **1.5 Null Hypotheses**

The following null hypotheses were formulated for testing:

- Ho<sub>1</sub>: There is no significant difference in the mean scores of students exposed to low-level cognitive questions and those exposed to high-level cognitive questioning styles in integrated science at JSS level.
- Ho<sub>2</sub>: there is no significant difference in the mean scores of male and female students exposed to low-level cognitive questioning styles in integrated science at JSS level.
- Ho<sub>3</sub>: There is no significant difference in the mean scores of male and female students exposed to high-level cognitive questioning styles in integrated science at JSS level.
- Ho<sub>4</sub>: There is no significant difference in the mean scores of students exposed to low-level and high-level cognitive questioning styles on retention ability in integrated science at JSS level.

### **1.6 Significance of the Study**

Teachers need to be aware of the importance of asking questions at different cognitive levels. It is therefore hoped that the findings of this study will:

- i. Encourage teachers to ask both low-level and high-level questions while teaching.
- ii. Encourage publishers to incorporate all levels of questions in their books.
- iii. Provide empirical evidence on how to improve the teaching/learning of integrated science in schools.
- iv. Encourage curriculum planners to incorporate low-level and high-level questions in planning the curriculum.
- v. Also form a foundation for further studies in science education in relation to questioning styles.

### **1.7 Delimitation of the Study**

This study was confined to Junior Secondary Schools in Giwa Inspectorate Division of Kaduna State. Two government co-educational schools were randomly selected by using table of randomization. The topic science in the service of the community was taught to the two groups.

## **CHAPTER TWO**

### **REVIEW OF LITERATURE**

#### **2.1 Introduction**

This study investigates teachers' cognitive questioning styles and their effects on academic achievement of junior secondary school integrated science students. In this chapter literature relevant to the study is reviewed as follows:

- The Concept, Philosophy and Objectives of Integrated Science
- Description of Cognitive Domain
- Cognitive Questioning Styles
- Low-level Cognitive Questioning Styles
- High-Level Cognitive Questioning Styles
- Cognitive Questioning Styles and Academic Achievement in Science
- Cognitive Questioning Style and Retention
- Gender, Cognitive Questioning Styles and Academic Achievement in Science.
- Similar Studies on Cognitive Questioning Styles and Academic Achievement in Science.
- Implications of the Literature Reviewed to the Present Study.

#### **2.2 The Concept, Philosophy and Objectives of Integrated Science**

Integrated Science can be defined as unified knowledge of basic sciences, it is also an inquiry oriented subject in which practical oriented lessons/activities are very essential.

Several people have tried to group the concept of integrated science. Brown (1977) viewed integrated science in four broad grouping:-

1. Unity of knowledge as essentially one and unified (holist view).
2. The conceptual unity of the sciences in which various conceptual units that make up the framework are identified e.g concept of energy.
3. A unified process of scientific enquiry which emphasize on the different method of enquiry.
4. An inter-disciplinary study involving collaborative venture between subjects and viewing it in a topical or theme level.

Integration when applied to a science course means that the course is fused and presented in such a way that students gain the concept of the fundamental unity of science, the commonality of approach to problems of a scientific nature; and are helped to gain an understanding of the role and function of science in their everyday life and the world in which they live. An integrated science course eliminates the repetition of subject matter from the various sciences and does not recognize the traditional subject boundaries when presenting topics and activities. Integrated principles, therefore, are intended to produce a course which:-

- Is relevant to student's needs and experiences;
- Stresses the fundamental unity of sciences;
- Lays adequate foundation for subsequent specialist study and;
- Add a cultural dimension to science education.

Teaching science as a unit is assumed to mean that all sciences, as human endeavour, is taken as the source of educational objectives and learning activities. And that the traditional boundaries among the separate sciences are minimized considerably for these purposes. Abah (1991) defines integrated science as a science course which:-

- Makes use of subject matter from various disciplines;
- De-emphasizes the boundaries between different disciplines in the organization and presentation of subject matter;
- Consciously seeks to blend the subject matter from various disciplines by organizing them under common themes/conceptual schemes/major concepts and science processes;
- Provides opportunities for practicing of scientific knowledge and skills to solve human problems;
- Relates science to the environment of the learners;
- Makes use of relevant psychological theories of learning in the organization and presentation of subject matter;
- Provides adequate foundations for further studies in the sciences.

Therefore integrated science expresses the fundamental unity of scientific thought and the various science process skills to solve human problems, so that students can achieve the content knowledge of science in an investigative way. The question styles

students are exposed to involved the two levels of cognitive questioning styles i.e low-level and high-level. In this study therefore, the aspect of the effectiveness of cognitive questioning style on academic achievement in integrated science was investigated.

In order to determine the philosophy and objectives of integrated science, it was considered necessary to review the relevant portions of the National Policy on Education as they relate to science education in general and to integrated science in particular. It is clear from the National Policy on Education (FME, 2004) that secondary education is expected to be:

- Preparation for useful living within the society;
- Preparation for higher education;
- Equip students to live effectively in our modern age of science and technology integrated science course according to National Policy on Education (FME, 2004) is devised and presented in such a way that the child:
  - Gain the concept of the fundamental unity of science;
  - Gain the commonality of approach to problem of a scientific nature;
  - It helps to gain an understanding of the role and function of science in everyday life, and the world in which he/she lives, then the methodology of the presentation by the teacher is very crucial.

To be able to achieve the objectives of integrated science laid down, one of the things that can be looked at is the mode of interaction between the teachers and the students. The teacher's questioning style not only will keep the students actively involved during the lesson but also will help the students have opportunity to openly express their ideas and thoughts and thus help them gain the concept of integration. Therefore, the study is aimed at finding out the effect of questioning styles of the teachers on academic achievement of students in integrated science.

### **2.3 Description of Cognitive Domain**

Cognitive domain according to Bloom's et al. (1956) included those objectives that deal with the recall or recognition of knowledge and the development of intellectual abilities and skills. The cognitive domain identified six levels of objectives, the least complex being knowledge. Ranking above knowledge in order of increasing complexity

are the cognitive skills of comprehension, application, analysis, synthesis and evaluation. Each level is presumable more complex than the preceding level and assumes inclusion of the previous levels. The evaluation is the most complex skill because it requires the application of all the other lower skills. Bloom's taxonomy (1981) described the six major categories of learning in the cognitive domains and their illustrative verbs as follows:-

1. **Knowledge:** is defined as the remembering of previous learned material. This may involve theories, but all that is required is the bringing to mind of the appropriate information. Knowledge represents the lower level of learning outcomes in the cognitive domain using verbs such as define identify, give example, rewrite, list, etc are the behavioural terms:
2. **Comprehension:** is defined as the ability to grasp the meaning of a material. This may be shown by translating a material from one form to another. The learning outcome goes one step beyond the simple remembering of material and represent the lowest level of understanding using verbs as change, convert, defend, predict, rewrite, give example, etc. are the action verbs to illustrate the comprehension level.
3. **Application:** refer to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws and theories. Learning outcome in this area requires a higher level of understanding of the material than those under comprehension. Examples of words used are change, relate, show, solve demonstrate, discover, manipulate, etc are the illustrative terms for application.
4. **Analysis:** refers to the ability to breakdown a material into its component parts so that its organization structure may be understood. This may include the identification of the parts and analyzing of the relationship between parts and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than comprehension and application because they require an understanding of both content and the structural form of the material. Examples of verbs used are differentiate, discriminate, distinguish, outline, breakdown, illustrate, point out among others are the illustrative terms for analysis.

5. **Synthesis:** refers to the ability to put together to form a new whole. This may involve the production of a unique communication; a plan of operations (research proposal) has set of abstract relations (scheme for classifying information). Learning outcome in this area stresses creative behaviour with major emphasis on the formulation to have patterns of structures. Examples of verbs used are categorize, device, explain, revise, summarize, write, reconstruct, generate, among others are the behavioural terms.
6. **Evaluation:** is concerned with the ability to judge the value of material (statement, research report) for a given purpose. The judgments are to be based on definite criteria. These may be internal criteria (organization) or external criteria) (relevance to the purpose) and the student may determine the criteria or be given them. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgments based on clearly defined criteria. Examples of words used are compare and contrast, explain, relate, describe, criticize, discriminate, summarize among others are the action verbs.

Teachers in interacting with the students are expected to make use of all the levels. Some teachers make use of the lower levels while others make use of higher level. This study investigates if teachers cognitive questioning styles affect academic achievement of students in integrated science.

#### **2.4 Cognitive Questioning Styles**

Questions according to Morgan and Saxton (1991) is one of the most popular modes of teaching. The act of asking questions has the potential to greatly facilitate the learning process. It is possible to transfer factual knowledge and conceptual understanding through the process of asking questions. Morgan and Saxton (1991) posited that teachers ask questions for the following reasons:

- To help teachers keep students actively involved in lessons;
- To help students have opportunity to openly express their ideas and thoughts;
- To enable other students to hear different explanations of the materials by their peers;
- To help teachers pace their lessons and moderate student behaviour;

- To help teachers evaluate students' learning and revise a lesson as necessary.

Questions teachers pose are cues to their students' level of thinking expected of them, ranging from the lowest level of mental operation, requiring simple recall of information, to the highest level requiring higher thought and application of that thought (Derfel, 2002). It is important that teachers are aware of the levels of thinking of their students such as low to high-level of operations. Researchers like Cotton, (2001); Derfel, (2002) identified two broad types of teacher questioning; the low-level and the high-level cognitive questioning styles.

#### **2.4.1 Low-level Cognitive Questioning Styles**

Low-level cognitive questioning styles are called gathering, verbatim recall or recognition of factual information previously read or presented by a teacher. At this level questions are designed to solicit from students' concepts, information, feelings or experiences that were gained in the past and stored in memory (Derfel, 2002). Sample key words and desired behaviours are complete, count, define, identify, list, match, name, observe, recall, recite and select. In his research, Ellis (1993) claimed that many teachers do rely on low-level cognitive questions in order to avoid a slow-paced lesson, keep the attention of the students and maintain control of the classroom. Therefore all questions that test recall of learned materials, explanations or application of knowledge in Bloom's taxonomy of educational objectives fall under low-level cognitive questioning style. These are usually at the lowest level of cognitive processes and answers are frequently either right or wrong (Erickson, 2007). Answers to these types of questions are usually within a very finite range of acceptable accuracy. These may be at several different levels of cognition like comprehension, application, analysis, or ones where the answerer makes inferences or conjectures based on personal awareness, or on material read, presented or known (Lindley, 2003).

#### **2.4.2 High-level Cognitive Questioning Styles**

High-level cognitive question styles are used in applying and evaluating new situations and require the students to mentally manipulate bits of information previously learned, to create or support an answer with reasoned evidence. Questions at this level

encourage students to think intuitively, creatively and hypothetically, to use their imaginations, to expose a value system, or to make judgment. Sample key words and desired behaviors are; apply a principle, build a model, evaluate, explain, compare, contrast, describe, discriminate, predict, discuss and generalize. High-level cognitive questions require the students to think creatively by learning the comfortable confines of the known and reaching out into the unknown (Derfel, 2002). They are questions that test high order thinking questions in the area of analysis, synthesis and evaluation in Bloom's taxonomy of educational objectives and are recorded as high-level cognitive questioning style.

High-level cognitive questions allow students to explore different avenues and create many different variations and alternative answers or scenarios. Correctness may be based on logical projections, may be contextual, or arrived at through basic knowledge, conjecture, inference, projection, creation, intuition, or imagination. These types of questions often require students to analyze, synthesize, or evaluate a knowledge base and then project or predict different outcomes (Erickson, 2007). This study investigated the effect of low-level and high-level cognitive questioning styles asked by the teacher on academic achievement of students in integrated science.

## **2.5 Cognitive Questioning Styles and Academic Achievement in Science**

Academic achievement is the measure of student's learning or acquisition of certain skills at the end of teaching and learning activities. Due to the importance of academic achievement in school programmes, various science educators gave their definition of academic achievement.

Marshall (1971) defined academic achievement as the extent to which a person has achieved something, acquire certain information or mastered certain skills, usually as a result of planned instruction or training. Inyang (1988) defined academic achievement as assessment of how much students have learnt or attained after a learning period.

The cognitive interaction between teachers and students promotes students' achievement (Gandu, 2006). According to him, the more frequently a teacher asks questions the more the students will be disposed to higher achievement. During a lesson, questions are expected to probe the students' understanding of the learning task

presented. The results of such probes provide the teacher with the necessary feedback concerning the extent to which learning has taken place.

The cognitive level of a question refers to the nature of cognitive processing required to answer it. The content of high-level and low-level cognitive question styles and the manner in which teachers ask them determine whether or not they are effective. In a research finding Chuska (1995), stated that some mistakes that teachers make during the question and answer process include the following: asking vague questions, asking trick questions, and asking questions that may be too abstract for students. When question such as those mentioned are asked students will usually not know how to respond and may answer the questions incorrectly. According to him, their feeling of failure may cause the students to be more hesitant to participate in class; this will affect their academic achievement and even evoke some negative attitude towards learning, and hinder the creation of a supportive classroom environment.

In another study Brualdi, (1998) and Cotton, (2001) found that higher cognitive questioning styles is superior to lower cognitive questioning styles. According to them, students taught with high-level cognitive questioning styles performed better than those taught with low-level cognitive questioning styles. Teachers must be sure that they have a clear purpose based on their questioning styles rather than encouraging knowledge type of questions.

Wilén and Clegg (1986) supported this assertion when they suggest that teachers should employ high level cognitive questioning styles to foster higher students achievement. Using the following procedures.

- Phrase questions clearly
- Ask questions of primary academic nature
- Allow three to five seconds of wait-time after asking a question before requesting a student's response, particularly when high-level cognitive questions are asked.
- Encourage students to respond in some way to each question asked.
- Balance responses from volunteering and non volunteering students.
- Elicit a high percent of correct responses from students assist with incorrect responses.

- Probe students' responses to have them clarify ideas, support a point of view, or extend their thinking.
- Acknowledge correct responses from students and use praise specifically and discriminately.

Therefore, good questioning styles foster students' academic achievement and build the learners varying forms of thinking. Effective questioning styles are directed towards learning and evaluative thinking rather than determining what has been learned in a narrow sense.

## **2.6 Cognitive Questioning Styles and Retention**

Retention is the ability to remember and consequently recall things experienced or learnt by an individual at a later time (Bichi 2002). He further stated that understanding and retention are products of meaningful learning when teaching is effective and meaningful to the students. Britannica Encyclopedia (2003) added that the ability to solve any problem or even to recognize that a problem exists depends on memory. Practice or review tends to build and maintain memory for a task or any learned materials. Britannica Encyclopedia (2003) further stated that in measuring retention, the rate tends to vary with the methods used and they are basically those of recall, recognition and relearning. Retention takes place when learning is coded into memory. Thus, appropriate coding of incoming information provides the index that may be consulted so that retention takes place without an elaborate search in the memory. (Oyedokun,1998, in Bichi, 2002). The nature of the material to be coded contributed to the level of retention.

Fisher (2005), compared the effectiveness of outdoor laboratory teaching method and the indoor laboratory method with reference to achievement, retention and attitude. He found that students exposed to outdoor laboratory teaching method have higher cognitive achievement, more positive attitude and higher retention ability than their counterparts taught using the indoor laboratory teaching method. Since laboratory method involve higher level of thinking which need the use of high-level cognitive questioning styles. Fisher (2005), found that it enhances students' academic achievement and retention in science. Therefore in this study the effectiveness of low-level and high-level cognitive questioning styles on retention was investigated.

Measurement of retention as used in this study combined both recall, and recognition methods where subjects were helped to remember and reproduce previous learned information when offered to the subject at a later time.

## **2.7 Gender, Cognitive Questioning Styles and Academic Achievement in Science**

For a country to advance in science and technology, the general community (males and females alike) need to increase in scientific and technological knowledge and competence. That is the females should participate and contribute along side their male counterparts in the development of science and technology, and hence the development of the nation. Barton (1998) observed that one of the most popular and most powerful phrases connected to science education reform in the last decade has been “Science for all”. Against its reality and in conformity with world trends the government of Nigeria has demonstrated her strong commitment to the cause of woman education generally, and in particular, their participation, in science and technology through policies, programmes, activities etc. This has led to such project as GIST (Girl Into Science and Technology), WISE (Women in Science and Engineering), GASAT (Gender And Science And Technology).

Despite these efforts, available statistics on enrolment in secondary schools as well as institutions of higher learning showed that much fewer females than males engage in science and technology (Aigboman, 2002, Okeke, 2001). Several studies have focused on gender differences and academic achievement in science learning. The difference seems to be most pronounced in the physical sciences, (chemistry and physics) with concerns that girls are not achieving as much as they should compared to boys (Harding and Whiteleg 1997).

Many studies have pointed to the fact that male students are academically superior to their female counterparts in mathematics, and sciences Ibeme (1975); Inomiesa (1985); Usman (2000) revealed no gender difference in both academic achievement of male and female students in science. On a larger level, excluding women from science in the classroom sets the stage for a huge decline in scientific literacy for the whole society. This makes the public less savvy consumers of scientific information, and more likely to be exploited, deceived, or simply confused by pseudo-scientific claims (Microsoft

Encarta Reference Library 2005). The gender difference that exist in science achievement have been linked to the way science is being taught in the classrooms (Harding and Whiteleg 1997; Aigboman, 2002). Furthermore Usman (1992) and (2000) in a research on the effect of practical activities in integrated science using the NISTEP mode of teaching.

The issue of gender differences is still a controversy, even though the literature cited above were on gender in relation to achievement and practical activities performance in science. The aspect of teachers' cognitive questioning styles was not investigated which might be another factor for gender differences. This study therefore aimed at finding out if teachers' cognitive questioning styles have effect on the academic achievement of male and female students in junior secondary school integrated science.

## **2.8 Similar Studies on Cognitive Questioning Styles and Academic Achievement in Science**

This study seeks to investigate the effect of teachers' cognitive question styles on academic achievement of the junior secondary school integrated science students. Researches by (Wilén, 1991; Ellis, 1993; Arends, (1994) shows that teachers' questioning styles is predominantly based on simple recall of facts already at recall level (low-level). These are questions that have a simple answer which the students is expected to know. Low-level questions are used to determine the students' knowledge about factual information.

In a research study carried out by Martins (1989) in on the classification of types of questions based on the cognitive domain of Blooms taxonomy of educational objectives, of the 266 questions asked in the integrated science NISP pupils textbook one, two and three, only one of the questions was classified as belonging to the affective domain, none in the psychomotor domain, while 265 questions were in the cognitive domain. From the distribution of questions according to Bloom's taxonomy of educational objectives (cognitive domain), 96 questions of the total question were categorized into knowledge, while 129 questions were in the comprehension level. Application has a total of 30 questions, and 5 questions were for analysis, only one question was recorded for evaluation and no question was classified under synthesis.

From the distribution of questions, it can be seen that most of the questions are in the lower levels of knowledge. Most of the teachers questions do not cater for the aspect of evaluation levels.

In a similar research carried out by Mani (1982); Usman (2001) using teacher-made class examination as one of the six variables observed as one of the classroom behavior in NISP implementation. The items examined showed that the examination consisted of mainly item for testing students recall, comprehension and application of information while items of higher process skills such as synthesis and evaluation were totally absent.

Gandu, (2006) observed that the questions set by Educational Resources centers (ERC) are mostly based on Blooms' taxonomy of educational objectives (Cognitive domain). Since teachers' cognitive questioning styles is based on low-level questions, the performance of students in integrated science at junior secondary school level will be jeopardized because of their non exposure to all the levels of cognitive questioning styles on academic achievement of students in integrated science at junior secondary school level.

Meanwhile, Cooter and Flynt (1989), stated that lower cognitive question styles are more effective when teacher's purpose is to impart factual knowledge and assist students in committing this knowledge to memory. Example, asking students to name the parts of a flower. However, since low-level questions are used to reinforce learning and to check on students retention, teachers must structure questions in a way intended to move student's thinking to higher levels as it makes the students think and apply learning in new ways (Derfel, 2002). This also allows the teachers to determine whether generalizations are being made, so as to enhance the students' academic achievement.

In similar studies Susan, (2001) and Cotton, (2001) emphasized that higher order question which require thought rather than memory increase a student's achievement. According to them, high-level cognitive questions take the learner into new territory, it requires the students to take existing knowledge and synthesize new knowledge. It can also be to get at the students underlying assumptions, beliefs about a scientific concept. Teachers should prepare questions that have purpose and focus and are worded correctly so that students know what is being asked and are at the correct level of cognitive

difficulty (Cotton, 2001). The more frequently teachers ask questions in science classes, the greater the achievement level of the students.

Questioning students in a way that let their minds run free leads to good responses and good learning (Cotton, 2001). According to her teachers who use combination of high-level and low-level cognitive questioning styles and those who increase their questions of high-level inquiry are more likely to raise student's achievement. Questions which focus student attention on salient elements in the lesson result in better comprehension, than questions which do not (Stiggins and Liston 2006). According to them instruction which includes posing questions during lessons is more effective in producing achievement gains than instruction carried out without questioning students.

In similar studies Dillon (2005) observed that the cognitive level of questions posed is unrelated to students attitudes toward the subject matter. According to him students who prefer low-level cognitive questions perform better in recitations and on tests where lower cognitive questions are posed. Those students who prefer high-level cognitive questions perform equally well with high or low-level cognitive questions in recitations and on tests. Therefore teachers who vary their questioning behaviours and use approaches other than questioning during classrooms discussions are positively related to students' achievement.

In his research Smith (2007) stated that teachers should incorporate questioning into classroom teaching/learning practices. According to him teachers should ask a majority of low-level cognitive questions when instructing younger and lower ability students and ask a majority of high-level cognitive questions when instructing older and higher ability students. He stated that in settings where high-level cognitive questions are appropriate, is positively related to the achievement of the students.

In similar studies (Samson and Strykowski 2008) emphasized that questioning is second only to lecturing in popularity as a teaching method. Therefore this study deems it necessary to find out if a teacher's mode of cognitive questioning styles has an effect on the academic achievement of students at junior secondary school integrated science.

## **2.9 Implications of the Literature Reviewed on the Present Study**

The literature reviewed shows that studies on teachers cognitive questioning styles was conducted at Senior Secondary School level. Gandu, (2006) carried out his study at senior secondary school level in Biology. This type of study is required at the junior level most especially integrated science. Therefore this study is indebted in depth to test the effectiveness of low-level and high-level cognitive questioning styles more especially in integrated science at the junior secondary school level.

Some of the literature reviewed also reported significant gender difference with respect to academic achievement in science, which prompts this study to look into gender related issues. The studies reviewed in this chapter covered a broad range of issues of teachers' cognitive questioning styles, academic achievement in science and retention ability of students in integrated science at JSS level. The study also explored some of the shortcomings of similar studies with a view to improve them.

## CHAPTER THREE

### METHODOLOGY

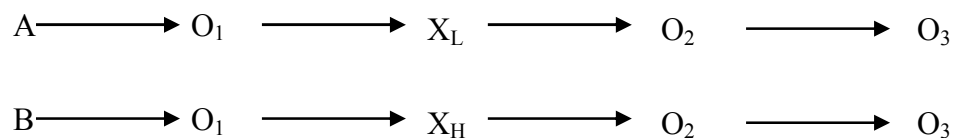
#### 3.1 Introduction

This study investigated teachers' cognitive questioning styles and their effects on academic achievement of integrated science students of Junior Secondary School two in Giwa Inspectorate Division of Kaduna State. The chapter is discussed under the following subheadings:

- Research Design
- Population of the Study
- Sample and Sampling Procedure
- Instrumentation
- Pilot Study
- Administration of Treatment
- Data Collection Procedure
- Data Analysis Technique

#### 3.2 Research Design

The research is a pretest, posttest and post-posttest quasi experimental design. This type of design was in line with recommendation of Kelinger (1973). In the design, the study subjects were divided into two groups; a pretest was administered to both groups before treatment to determine the equivalence of the subjects. The treatment involved teaching the subjects using low-level questioning style for group A and high-level questioning style for group B. The treatment lasted for 6 weeks after which posttest was administered to the two groups. Two weeks after, a post-posttest was administered. This was to determine the retention level of the subjects in the concepts taught. The design is graphically illustrated as follows:



Where:

A – Group A exposed to low-level questioning styles

B – Group B exposed to high-level questioning style

O<sub>1</sub> – Pretest

O<sub>2</sub> – Posttest

O<sub>3</sub> – Post –posttest

X<sub>L</sub> – Low-level cognitive questioning styles

X<sub>H</sub> – High-level cognitive questioning styles

### **3.3 Population of the Study**

The population of this study drawn from all the junior secondary schools located within Giwa Inspectorate Division of Kaduna State. There are 30 schools within the division out of which 23 are government owned while 7 are privately owned. Out of the 23 government owned 2 are female only while 21 are co-educational. All the 7 privately owned secondary schools are co-educational. The target population was made up of second year Junior Secondary School students (JSS 2) with an average age of 13 years. The population comprised of 3,826 subjects made up of 2,570 males and 1,256 females. The details of the schools in the target population are presented in Table 3.1.

**Table 3.1: Population of the Study**

S/No	Name of schools	Status	No. of Enrolment		Total
			Male	Female	
1.	Dr. S.L.G.G.S.S Giwa	Females only	-	203	203
2.	G.S.S. Giwa	Co-educational	226	36	262
3.	G.S.S Fatika	Co-educational	71	12	88
4.	G.S.S. Gangara	Co-educational	74	26	100
5.	G.S.S. Yakawada	Co-educational	124	36	160
6.	G.J.S.S Danmahawayi	Co-educational	56	05	61
7.	G.J.S.S Iyatawa	Co-educational	33	05	38
8.	Y.A.S.S Shika	Co-educational	179	36	215
9.	G.J.S.S Bomo	Co-educational	316	78	394
10.	G.J.S.S Samaru	Females only	-	346	396
11.	G.J.S.S. Yan-Sarki	Co-educational	69	01	70
12.	G.S.S Basawa	Co-educational	228	82	310
13.	G.J.S.S Galadimawa	Co-educational	30	05	35
14.	G.S.S Kwangila	Co-educational	170	142	312
15.	G.J.S.S Kaya	Co-educational	90	05	95
16.	G.J.S.S. M/Guga	Co-educational	67	13	80
17.	G.J.S.S Jama'a	Co-educational	148	82	230
18.	G.J.S.S Sakadadi	Co-educational	35	04	39
19.	G.J.S.S K/Wali	Co-educational	90	20	110
20.	G.S.S. Kudan	Co-educational	214	36	250
21.	G.J.S.S Dokan kudan	Co-educational	29	05	64
22.	G.S.S Hunkuyi	Co-educational	192	69	259
23.	G.S.S Kidandan	Co-educational	99	09	108
		<b>Total</b>	<b>2570</b>	<b>1256</b>	<b>3824</b>

### 3.4 Sample and Sampling Procedure

For the sample of the study, six co-educational schools were purposefully selected from the 23 Government schools using purposeful sampling technique in Table 3.1. Purposeful selection was done because the schools selected contains large number of male and female students which are suitable for the study in order to cater for female issues as stated in hypothesis two of chapter one. The sample is presented in Table 3.2 previously.

**Table 3.2: Sample of the Study**

S/No	Name of schools	Type of school	No. of Enrolment		Total
			Male	Female	
1.	G.S.S Basawa	Co-educational	228	82	310
2	G.J.S.S Bomo	Co-educational	316	78	394
3.	G.S.S. Hunkuyi	Co-educational	192	69	216
4.	G.S.S. Jama'a	Co-educational	148	82	230
5.	G.S.S Kwangila	Co-educational	170	142	312
6.	G.S.S Yakawada	Co-educational	124	36	160
		Total	1,178	489	1,667

A pretest was administered on the subjects in the six schools using Integrated Science Achievement Test (ISAT). The Pre-test was done to determine the equivalence of the subjects in the six schools. The scores obtained were subjected to Analysis of Variance (ANOVA) statistical analysis. Ad-hoc test was used to determine the two groups that are equivalent in ability for the study. The two groups that were equivalent are Government Junior Secondary School Bomo and Government Junior Secondary School Kwangila. The two schools were randomly selected into A for low-level questioning styles and B for high-level questioning styles. For the purpose of this study, a total of 100 student of the two junior secondary 2 integrated science students were selected, 50 students from each of the two schools, 25 boys and 25 girls. Selection of the subjects was done by simple random sampling employing balloting method. Details of sample selected is shown in Table 3.2.

### 3.5 Instrumentation

The instrument that was used for data collection was Integrated Science Achievement Test (ISAT). Items in the ISAT were developed by the researcher on the topics taught. The ISAT consisted of thirty (30) test items based on the concept taught. The topic “Science in the service of the community” was taught in which 30 questions of low-level and high-level questions of multiple choice tests with four alternatives, one correct answer and three distractors. A table of specification was used to ensure even distribution of the items on the topics taught (see appendix F). The 30 questions cover the Bloom’s taxonomy levels of knowledge, comprehension, application, analysis, synthesis and evaluation in the cognitive domain.

The ISAT was administered to both groups, that is group A those exposed to low-level cognitive questioning style and group B those exposed to high-level cognitive questioning styles as pre and post test. A marking scheme was designed for marking the scripts as follows. The 30 multiple choice tests of low-level and high-level questions both carrying one (1) mark each. Total score for ISAT is 30. The test items were distributed in the table of specification for content taught in the study (see appendix G).

#### 3.5.1 Validity of the Instrument

To confirm the validity of the instrument in relation to the aim of the study, the thirty test items of low-level and high-level questions were subjected to scrutiny by 3 science education specialists in science education section of the education department of Ahmadu Bello University, Zaria. And also of 2 specialists teaching integrated science at JSS level.

The valuator’s were requested to:

- a. study the items and certify if the questions were considered to be testing the low-level and high-level cognitive questions.
- b. certify if they are appropriate for the level of students for which it is intended.
- c. check for possible errors in the suggested answers.

For an item to satisfy the requirement of content validity, it must enjoy the unanimous agreement of all panel members in respect of each purpose. Discrepant items were selected out of 45 items.

### 3.6 Pilot Study

The instrument for the study ISAT was pilot-tested using the JSS 2 students of Yusuf Aboki Secondary School, Shika. The instrument was administered twice within an interval of 2 weeks to 50 students. The pilot study was done to:

- i. find out the characteristics of ISAT items through item analysis;
- ii. determine the appropriateness of the length of time required to take the test;
- iii. determine the appropriateness of the wording of the ISAT; and
- iv. find the reliability of ISAT.

#### 3.6.1 Reliability of the Instrument

The reliability of the instrument was determined using test re-test method employing Pearson Product Moment Correlation Coefficient (PPMCC). Junior Secondary 2 student of Yusuf Aboki Secondary School Shika were used. The test was administered twice to fifty students within an interval of two weeks. The data collected were used to compute the reliability coefficient of the instrument.

The result of coefficient gave r value of 0.85 which indicated high correlation between the two tests, meaning that the instrument is reliable. Details of computation are given at the end of this report (See Appendix J).

#### 3.6.2 Item Analysis of ISAT

Item analysis was carried out on the scores obtained from the pilot study to determine the facility indices and the difficulty indices in the ISAT. The facility index (FI) of a test according to Wood (1990) is the percentage of candidates that got an item right. It is determined by using the formula.

$$F_1 = \frac{R}{T}$$

Where R = number of correct responses.

T = total number of students.

Satterly (1986); Inomiesa (1985) recommended values within the range of 0.30 to 0.70 for good test items values in assessing achievement. For the present study 0.30 to 0.70 was chosen for the study. (See Appendix H) the discrimination difficulty index

indicates the discriminating power of each of the test items, differentiating between high and low marking of the learners in the whole test. This calculation was done using scores of the top 27% and bottom 27% of the total respondents. This was calculated using the formula given by Furst (1958).

$$d = \frac{R_u - R_l}{\frac{1}{2} N}$$

Where d = discrimination index

$R_u$  = number among upper 27% of respondents

$R_l$  = number among lower 27% of respondents

N = total number of respondents

The discriminatory indices of a range between 0.30 to 0.70 is regarded as moderately positive and was accepted for the present study. This was used in selecting the final items of the (ISAT) see appendix I.

### **3.6.3 Selection of Content Taught in the Study**

The content taught to the subjects consisted of 6 topics. The content allowed the use of various levels of questioning styles i.e low-level and high-level cognitive questioning styles based on the objectives of the study. The topics are force, machines, use of energy and material in the community, food chain and food web, maintenance balance in the environment, wild life conservation. The topics were taught to the two groups A and B, using low-level cognitive questioning styles and high-level cognitive questioning styles for group B. These topics were selected for the following reasons.

- i. They form part of the junior secondary two Integrated Science Syllabus
- ii. The topics form a good representation of the major areas of Integrated Science (Physics, Chemistry and Biology).
- iii. They have not been taught in the schools under study as at the time of the research.

The Table of specification for content taught is presented in appendix (G).

### **3.7 Administration of Treatment**

Before treatment the two groups were found to be equivalent using the pretest. The groups were taught using the low-level and high –level cognitive questioning styles. The teaching lasted for six weeks.

The treatment in group A involved teaching the subjects using low-level cognitive questioning style. This involved using questions like define, list, state, mention, what, while teaching the subjects. The treatment lasted for six week, of 3 periods per week. The lesson plan for group A is in appendix D. The treatment in group B involved teaching the subjects using high-level cognitive questioning style. This involved using questions like explain, describe, differentiate, discriminate, compare and contrast, justify, write, while teaching the subjects. The treatment lasted for 6 weeks, of 3 periods per week. The lesson plan for group B is in appendix E.

After treating the two groups for a period of 6 weeks, the posttest was administered by the researcher. The subjects were post-pottested after two weeks of posttest using the same instrument to determine the retention ability of the two groups in the concepts taught. The items in the post-posttest, posttest and pretest are the same but are reshuffled to make them look different.

### **3.8 Data Collection Procedure**

A two group pretest and posttest treatment experimental design was used to collect data for the study. After the administration of the pretest, the teaching of the students on the chosen topics commenced. The teaching was done by the researcher and last for six weeks. After the six weeks treatment, the posttest was administered to the two groups by the researcher.

The researcher marked the scripts based on the marking scheme with a total of 30 marks. The scores from the scripts were recorded; also male and female scores were separated and recorded accordingly. The recorded scores were collated based on the two groups performances and were subjected to data and analysis using SPSS statistics. Subject's retention ability was determined two weeks later through the post-posttest procedure after rearrangement of the ISAT instruments.

### **3.9 Data Analysis Technique**

The data collected for this study were analyzed based on the stated hypotheses. The statistical tools used for data analysis was the t-test. A t-test was carried out on the posttest mean scores of subjects in the two groups at  $P \leq 0.05$  level of significance. The  $P \leq 0.05$  was set for retaining or rejecting the null hypotheses stated. The hypotheses are re-stated as follows:-

H<sub>01</sub>: There is no significant difference between the mean scores of students exposed to low-level cognitive questioning styles and those exposed to high-level cognitive questioning styles in integrated science at J.S.S. level.

H<sub>02</sub>: There is no significant difference in the mean scores of male and female students exposed to low-level cognitive questioning styles in integrated science at J.S.S levels.

H<sub>03</sub>: There is no significant difference in the mean scores of male and female students exposed to high-level cognitive questioning styles in integrated science at J.S.S level.

H<sub>04</sub>: There is no significant difference in the mean scores of students exposed to low-level cognitive questioning styles and those exposed to high-level cognitive questioning styles on retention ability in integrated science at JSS level.

## CHAPTER FOUR

### ANALYSIS, RESULTS AND DISCUSSION

#### 4.1 Introduction

This study investigated teachers' cognitive questioning styles and their effects on academic achievement of junior secondary school students in integrated science. In this chapter data analysis, results and discussion of the findings are presented. The data collected were analyzed using the SPSS.

#### 4.2 Data Analysis

Three types of data were collected using Integrated Science Achievement Test (ISAT) as follows:

- Pretest achievement scores of six groups. The data were analysed to establish two groups that are equivalent before starting the treatment.
- Posttest achievement scores of both groups A and B. These were analysed to see if there is a significant difference between the mean scores of the two groups which could be attributed to treatment.
- Post-posttest achievement scores of both groups. These were analysed to establish which of the two groups had a better retention of the learned concepts.

##### a. Hypotheses Testing

Each of the hypotheses formulated were tested and the results obtained are presented in the section below:

$H_0$ : There is no significant difference in the mean scores of students exposed to low-level and those exposed to high-level cognitive questioning styles in integrated science at JSS level.

To test this hypothesis, data collected were analyzed using t-test statistics at  $P \leq 0.05$ .

Table 4.1: **Summary of t-test Analysis of the Mean Scores of Students Exposed to Low-level and High-level Cognitive Questioning Styles in Integrated Science.**

<b>Group</b>		<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>SE</b>	<b>Df</b>	<b>t-cal.</b>	<b>P-value</b>
Low-level	(A)	50	12.94	4.21	0.59	98	1.36	0.17
High-level	(B)	50	11.76	4.59	0.64			

\*Not significant at  $P \leq 0.05$

From the result shown in Table 4.1 it was found that the t-value calculated is 1.36 and p-value of 0.17 obtained at level of confidence. This shows that there is no significant difference between students taught using low-level and those taught using high-level cognitive questioning styles. This implies that the level of achievement of student taught using low-level cognitive questioning styles is the same with students taught using high –level cognitive questioning styles. Hence the null hypothesis of no significant difference is retained.

$H_{02}$ : There is no significant difference in the mean scores of male and female students exposed to low-level cognitive questioning styles in integrated science at JSS level.

To test this hypothesis data collected were analysed using t-test statistics at  $P \leq 0.05$ . The result is shown in Table 4.2.

Table 4.2 **Summary of t-test Analysis of the Mean Scores of Male and Female Students Exposed to Low-level Cognitive Questioning Styles in Integrated Science.**

<b>Group</b>		<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>SE</b>	<b>df</b>	<b>t-cal.</b>	<b>P-value</b>
Low-level	(Male)	25	14.44	4.17	0.83	48	2.69	0.013
Low-level	(female)	25	11.44	3.75	0.75			

\*Significant at  $P \leq 0.05$

From the result shown in Table 4.2 it was found that the t-value calculated is 2.69. The p-value of 0.013 obtained at level of confidence. Showing that there is significant difference in the mean scores of male and female students exposed to low-level cognitive

questioning styles, in favour of the male students. Hence the null hypothesis of no significant difference is rejected.

H<sub>03</sub>: There is no significant difference in the mean scores of male and female students exposed to high-level cognitive questioning styles in integrated science.

A t-test statistics was used at  $P \leq 0.05$ . The result is presented in Table 4.3.

**Table 4.3 Summary of t-test Analysis of the Mean Scores of Male and Female Students Exposed to High –level Cognitive Questioning Styles in Integrated Science.**

<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>SE</b>	<b>df</b>	<b>t-cal.</b>	<b>P-value</b>
High–level (Male)	25	10.88	4.09	0.81	48	1.56	0.13
High-level (female)	25	12.64	4.96	0.99			

\*Not significant at  $P \leq 0.05$

The result shown in Table 4.3 indicates that the t-value calculated is 1.56 and p-value of 0.13 obtained at level of confidence. This shows that there is no significant difference between male and female students exposed to high-level cognitive questioning styles. Thus the null hypothesis which states that there is no significant difference is retained.

H<sub>04</sub>: There is no significant difference between the mean scores of students exposed to low-level and high-level cognitive questioning styles on retention ability in integrated sciences at JSS level.

A t-test statistics was used at  $P \leq 0.05$ . The result is presented in Table 4.4.

**Table 4.4 Summary of t-test Analysis of the Mean Scores of Students Exposed to Low-level and High-level Cognitive Questioning Styles on Retention Ability in Integrated Science.**

<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>SE</b>	<b>df</b>	<b>t-cal.</b>	<b>P-value</b>
Low–level post-posttest	50	8.22	2.56	0.36	98	7.52	0.001
High-level post-posttest	50	12.46	3.20	0.45			

\*Significant at  $P \leq 0.05$

From the result in Table 4.4, the t-value calculated is 7.52 and p-value of 0.001 obtained is less than 0.05 at level of confidence. This shows that there is significant difference in retention ability in favour of students exposed to high-level cognitive questioning styles as indicated in their mean scores. The null hypothesis which states that there is no significant difference is therefore rejected.

#### 4.4 **Summary of Findings.**

At the end of this study, the following findings were obtained.

1. There is no significant difference in the mean scores of students taught using low-level and high –level cognitive questioning styles.
2. There is significant difference in the mean scores of male and female students exposed to low-level cognitive questioning styles.
3. There is no significant difference in the mean scores of male and female students exposed to high–level cognitive questioning styles.
4. There is significant difference in retention ability of students exposed to low-level and high-level cognitive questioning styles.

#### 4.5 **Discussion of Results**

##### **Null hypothesis 1**

The finding in Table 4.1 shows that there is no significant difference in the mean scores of students exposed to low –level and high –level cognitive questioning styles. This finding is in agreement with earlier findings of Wilen (1991), Ellis (1993), Arends (1994) who individually reported that low –level cognitive questions are simple and most frequently asked by teachers because they have simple answers which can easily be given by the students. The finding also agrees with the findings of Partin (2006), who stated that low –level questions are more effective when teacher’s purpose is to impact factual knowledge which is mainly being practiced by integrated science teachers using the lecture method of instruction.

The result agrees with the findings of Winne (2007), who found that students of teachers using a large proportion of high –level questions performed significantly better

on both the low –level and high –level questions of the posttest than those students whose teachers asked a larger proportion of low –level questions. It was concluded that the group achievement was significantly affected by the level of inquiry required by the teachers questions. The students do not have good command of language to express themselves. Therefore, based on the discussion of this study, the integrated science teachers should encourage the use of both low-level and high-level cognitive questioning styles.

### **Null Hypothesis 2.**

This hypothesis focused on the achievement of male and female students exposed to low-level cognitive questioning styles. The result in table 4.2 indicates that there is significant difference in students performance at  $P \leq 0.05$  in favor of male students. This result is in agreement with the findings of Harding and Whiteleg (1997) and Aigboman (2002) who individually pointed out that male students performed significantly better than their female counterparts in sciences. This result disagrees with the findings of Usman (2001 and 2002) who revealed no gender difference in academic performance of male and female students in science. The boys are extroverts in manner and answer the questions quickly, because they don't feel shy.

### **Null Hypothesis 3**

This hypothesis focused on the mean scores of male and female students when exposed to high-level cognitive questioning styles. The findings in Table 4.3 indicates that there is no significant difference in male and female students when exposed to high-level cognitive questioning styles. This finding is in agreement with the report of Usman (1992) and (2000), Bichi (2002), Ogunboyede (2003), Gandu (2006) who independently reported that male and female students perform the same in academic achievement when expose to activity based teaching method and high–level cognitive questioning styles in science at secondary school level. The issue of no significant difference may be attributed to the use of lecture method which mostly encourages low-level questions (Usman 2000).

**Null Hypothesis 4.**

This hypothesis shows that the t-test conducted indicated that students exposed to high-level cognitive questioning styles performed significantly better than students exposed to low-level cognitive questioning styles in retention ability in integrated science. This result agrees with the findings of Gandu (2006) who found in his study that students exposed to high-level cognitive questioning styles have more retention ability in learning science. If the treatment had no effect, the two groups are expected to perform the same. This implies that high-level cognitive questioning styles enhances the retention ability level of integrated science students. The high-level questioning styles makes the learner to synthesize the new knowledge and ability to retain what is learnt (Susan, 2001; Cotton 2001). Hence the high-level cognitive questioning styles are important for effective learning and retention of scientific concepts.

## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

The focus of this study is to investigate teachers' cognitive questioning styles and their effects on academic achievement of junior secondary school students in integrated science. This chapter summarizes the whole study and is presented in the following subheadings:

- Summary of the study
- Major findings
- Conclusions
- Recommendations
- Limitations of the study
- Suggestion for further studies

#### 5.2 Summary

This study investigated teachers' cognitive questioning styles and their effects on academic achievement of junior secondary school students in integrated science in Giwa Inspectorate Division of Kaduna State. It also investigated the effects of gender related differences on the academic achievement of students.

The sample for this study comprised a total of 100 JSS 2 integrated science students drawn from two junior secondary schools in Giwa Inspectorate Division. They were selected by simple randomization. The two schools were:

- Government Junior Secondary School Bomo
- Government Junior Secondary School Kwangila.

The instrument used was Integrated Science Achievement Test (ISAT). It was used as pretest, posttest after treatment and post-posttest after two weeks of posttest to determine the retention ability of both groups.

A 30- item multiple choice instrument, the Integrated Science Achievement Test (ISAT) with a reliability coefficient of 0.85 was used to collect relevant data which were analyzed using t-test statistics at 0.05 level of confidence. Data collected from ISAT were analysed using the SPSS version.

The result of the t-test analysis indicates that there is no significant difference in the mean score of students when taught using low-level and high-level cognitive questioning styles (See Table 4.1). Result of hypothesis two indicates difference in the mean scores of male and female students when exposed to low-level cognitive questioning styles in favour of the male students (See Table 4.2). Hypothesis three indicates no significant difference in the mean scores of male and female students when exposed to high-level cognitive questioning styles. (See Table 4.3). The last hypothesis showed significant difference in the mean scores of students exposed to low-level and high-level cognitive questioning styles on retention ability in favour of students exposed to high-level cognitive questioning styles in integrated science at JSS level (See Table 4.4).

### 5.3 Major Findings

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

1. There is no significant difference in the mean scores of students taught using low-level and high-level cognitive questioning styles.
2. There is a significant difference in the mean scores of male and female students exposed to low-level cognitive questioning styles in favour of the male students.
3. There is no significant difference in the mean scores of male and female students exposed to high-level cognitive questioning styles.
4. There is a significant difference in retention ability of students exposed to low-level and high-level cognitive questioning styles in favour of students taught using high-level cognitive questioning styles.

### 5.4 Conclusions

The following conclusions can be drawn from the study that:

- When students are taught using low-level and high-level cognitive questioning styles, they do not differ significantly in their performance.
- The performance of male students is better than the female students when low-level cognitive questioning style is used.

- Both male and female students benefited equally when taught integrated science using high-level cognitive questioning style.
- Students taught using high-level cognitive questioning style retained concepts taught better than those taught using low-level cognitive questioning style.

From the findings of the study therefore, it was concluded that both low-level and high-level cognitive questioning styles enhances integrated science students academic achievement at JSS level. Hence integrated science teachers should endeavour to use both low-level and high-level cognitive questioning styles in the teaching of integrated science because of its potentiality to enhance JSS integrated science achievement as revealed in this study.

### 5.5 Recommendations

On the basis of the findings and conclusions emanating from this study, the following recommendations are made:

1. Teachers should learn to use both low-level and high-level cognitive questioning styles in the classroom.
2. Teachers should be trained in seminars, workshops, conferences on the use of cognitive questioning styles i.e the use of low-level and high-level questions, so as to enhance students' academic achievement.
3. It was discovered in the research gender plays an important role in learning the concept taught using low-level and high-level cognitive questioning styles. Therefore teachers should treat students equally in the class regardless of their gender difference.

### 5.6 Limitations of the Study

This study has some limitations which include the following:

1. The restriction of the study to only two junior secondary schools in Giwa Inspectorate Division of Kaduna State due to time constraint. A wider scope of the study may influence the findings.
2. The teacher used local language in some cases to explain certain facts to the students. This might have some influence on the students achievement.

### 5.7 **Suggestions for Further Studies**

This study may be expanded or furthered in the following ways:

1. Similar studies in other science subjects may be carried out to see if questioning styles (low-level and high-level) may facilitate students achievement.
2. Since the study was done using junior secondary school students, similar studies using senior secondary school students, higher institutions of learning may be worthwhile.
3. There is need to further investigate the effect of questioning styles using activity based method such as problem solving, inquiry method of teaching among others.

## References

- \_Abah, G. (1991). A Study of Differences in Performance Between Male and Female Students in Science Subjects across three selected Cognitive Levels.
- Adeniyi, E.O. (1997). An Analysis of the Relationship among Intended Curriculum in-use Curriculum and Students Cognitive Structure Associated with an Ecology Unit. Ph.D Dissertation, University of Wisconsin-Madison.
- Aigboman, D.O. (2002). Science for all: Implication for the Teacher and National Development. Anibik Press, Benin City.
- Arends, R. (1994). Learning to teach, NewYork, NY: McGraw – Hill, Inc.
- Bajah, S.T. (1988). Teaching Integrated Science Creatively Ibadan University Press, Ibadan Nigeria.
- Barton, A.C. (1998). Teaching Science with Homeless Children. Pedalogy, Representation and Identity. Journal of Research in Science Teaching 35 (4)379-394.
- Bichi, S.S. (1988). The Design of Inventory Skills in Senior Secondary School Practical Biology, Unpublished M.Ed Thesis A.B.U, Zaria.
- Bichi, S.S. (2002). Effects of Problem Solving Strategy and Enriched Curriculum on Secondary School Students Achievement in Evolution Concepts. Unpublished PhD Dissertation, A.B.U. Zaria.
- Black S. (2001). Ask Me a Question. How Teachers use Inquiry in the Classroom. American School Board Journal.
- Bloom B.S. (1981). Taxonomy of Educational Objectives Handbook 1 Cognitive Domain. New York: David Mckay. The New Direction in Educational Research and Measurement. Invited Address AERA, April.
- Blooms, B.S., Furst E.J. & Englehart, M.J (1956). Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1: Cognitive Domain. New York: David Mckay.
- Britannica Encyclopedia 2003.
- Brown, S.A. (1977). Review of the meaning and Argument for Integrated Science Studies in Science Education 4, 31-62.
- Brown, S.A. (1977). Towards Effective Teaching of Integrated Science in Africa. Journal of the Science Teachers' Association of Nigeria 18 (1) 88-95.

- Brualdi, A. (1998). *Classroom Questions*. Washington, D.C: Clearing House on Assessment and Evaluation (ED422407).
- Callahan, J.F. & Clark, L.H. (1988). Teaching in the middle and Secondary Schools 3<sup>rd</sup> ed. New York: Macmillan Publishing Company.
- Chuska, K. (1995). *Improving Classroom Questions: A Teacher's Guide to Increasing Student Motivation, Participation and Higher Level Thinking*. Bloomington, IN: Phi Delta Kappa Educational Foundation.
- Cooter, B.& Flynt, F.E. (1989). Reading Comprehension out of the Ivory Tower and unto the Classroom. Paper Presented at the annual Meeting of the College Reading Association Washington, D.C.
- Cotton, K. (2001). Classroom Questioning. Northwest Regional Educational Laboratory. School improvement Research Series (SIRS).
- Daramola, S.O. (1983). The Influence of Location and Sex Difference on the Knowledge of Basic Physics Process by Entering form III Students in Kwara State Secondary Schools. Journal of Science Teachers' Association of Nigeria, 21(2) 106-112.
- Derfel, E.D. (2002). Cognitive Questioning in Education @everything2.com.htm.
- Dillon, J.T. (2005). *Teaching and the Art of Questioning*. Bloomington, In: Phi Delta Kappa Educational Foundation.
- Erickson, H.L. (2007). Concept-based Curriculum and Instruction for the Thinking Classroom. Thousand Oaks, CA. Corwin Press.
- Ellis, K. (1993). Teacher Questioning Behaviour and Student Learning: what Research says to Teachers (Paper Presented at the 1993 Convention of the Western States Communication Association, Albuquerque, New Mexico (Ed 359 572).
- Fakorede, A.D. (1999). A Survey into Gender differences and Students Achievement in Secondary School Biology. A Case Study of Oyo State. A Published M.Ed Research Programme University of Ibadan.
- Fisher, J.A. (2005). The Demise of Fieldwork as an Integral Part of Science Education in Schools: A Victim of Cultural Change and Political Pressure. Pedagogy, Culture and Society 9 (1), 75-96.
- Furst, E.J. (1958). Constructing Evaluation Instrument, Longman, Green Company New York.

- Gall, M.D. (1970). The Use of Questions in Teaching. Review of Educational Research 40, 5, 707-21.
- Gandu, A.A. (2006). A Comparative Analysis of Teacher's Cognitive Question Styles on Academic Achievement of Senior Secondary Biology Students. An Unpublished P.G.D.E. Research Programme Ahmadu Bello University, Zaria.
- Harding, J. and White Leg, E. (1997). Encore Gender, Science and Technology –Where are they now? Science Education Newsletter, 135,9.
- Hargreaves, D.H. (1984). Teachers Questions: Open, Closed and Half-open. Educational Research, 26, 46, 51.
- Ibeme, V.C. (1975). A Study of Sex difference in Maths ad English Language at Primary School level. Unpublished B.Ed Thesis University of Nigeria Nsukka, Nigeria.
- Iliya G.B. (2001). Relationship Between Students' Performance in Chemistry and Qualifying Examination and SSCE in Dala L.G.A of Kano State. An Unpublished P.G.D.E. Research Programme F.C.E, Kano.
- Inomeisa, T. (1985). The Development, Validation and Use of Standardized Instrument for the Continuous Assessment of Pupils Achievement in Upper Primary Science. Unpublished Thesis University of Nigeria Nsukka, Nigeria.
- Inyang, N.E. (1988). The Construction, Validation, Standardization of Integrated Science Achievement test for Junior Secondary School. Unpublished Ph.D Thesis, A.B.U., Zaria.
- Jegede, O.J. (1981). An Evaluation of the Nigerian Integrated Science Project (NISP). After a Decade of use in the Classroom. International Review of Education 28, 321-336.
- Keeves, J.P. (1973). Differences Between Sexes in Mathematics and Science courses. International Review of Education 19(1) 47-63.
- Kerlinger, F.N. (1973). Foundation of Behavioural Research Holt Rinehurt and Winston London.
- Lindley, D. (2003). This Rough Magic. Westport, CN. Bergin and Garvey.
- Mani, T.C. (1981). A Study of some Aspects of Intended and Operational forms of the Science Teachers' Association of Nigeria (STAN) Integrated Science Curriculum. Unpublished Ph.D Thesis A.B.U., Zaria.

- Mari, J.S. (1994). The Understanding of Science Processes and its Relationship to Achievement in Integrated Science. Published M.Ed Thesis Department of Education A.B.U., Zaria.
- Marshal, H. (1971). Classroom Test Construction. Addition Wesley Publication Company.
- Martins, O.O. (1989). An Evaluation of the Integrated Science Questions in the Nigerian Integrated Science Project (NISP). A Paper Presented at the Science Education Seminar of the Department of Education Ahmadu Bello University, Zaria.
- Microsoft Encarta Reference Library (2005).
- Morgan, N. & Saxton, J. (1991). Teaching, Questioning, and Learning. New York: Routledge.
- Ogunboyede, M.O. (2003). Sex Differences and Students Achievement at the Primary School Level. The Nigerian Academic Forums, 5 (1), 152-155
- Okeke, E.A.C. (2001). Women in Science, Technology and Maths Education in Nigeria. Keynote Address at the 42<sup>nd</sup> STAN Annual Conference. Theme Women in Science, Technology and Maths Education in Nigeria, STAN Proceeding Pp.3-13.
- Olanrewaju, A.O. (1983). The Conception of Integrated Science by Pre-Service Teachers Proceedings of the 24<sup>th</sup> Annual Conference of STAN, 51-57.
- Olanrewaju, A.O. (1983). Stages of Cognitive Development of some Secondary Schools in Ondo and Oyo States of Nigeria. Educational Perspectives 2 .
- Oyedokun, C.A. (1998). Effects of a Conceptual Change Model on Students' Achievement Retention and Attitudes to Biology Concepts. Unpublished Ph.D Dissertation. Ahmadu Bello University Zaria.
- Partin, R.L. (2006). "How Effective Are Your Questions?" The Clearing House 52, 254 – 256.
- Redfield, D.L & Rousseau, E.W. (1981). A Meta-analysis of Experimental Research on Teacher Questioning Behaviour. Review of Educational Research 51, 237-45.
- Samson. G.E; Strykowski, B.; (2008). The Effects of Teacher Questioning Levels on Student Achievement Journal of Educational Research 80, 290 - 295
- Sattely, D. (1986). Assessment in Schools. Theory and Practice in Education. Basil Blackwell, Inc. New York, U.S.A. 107-109.

- Smith, L.R. (2007). The Effect of Lesson Structure and Cognitive Level of Questions on Student Achievement. Journal of Experimental Education 54, 44-49.
- Stiggings, R.J. and Liston, S. (2006). Guidelines on the Use of Instructional Questions as Classroom Assessment. Portland, OR: Northwest Regional Educational Laboratory, (draft)
- Usman I.A (2008). The Effects of Class Size on Students Academic Achievement in Integrated Science at Junior Secondary School Level. As Observed by A Journal of Science, Teacher and Maths Education 1 (1) 144 -149 Fed. Uni of Tech Minna.
- Usman I.A. (2002). Effect of NISTEP, mode of teaching on students Academic Achievement in Integrated Science, A Paper Presented at Science Teachers Associate of Nig. (STAN). Kaduna State Chapter, Held at Barewa College, Zaria. 31<sup>st</sup> May-1<sup>st</sup> June.
- Usman I.A. (2007). The Effects of Selected Methods of Teaching on the Academic Achievement of Slow Learners in Integrated Science at the Junior Level. Journal of Science & Mathematics Education 3 (1) 70-77 University of Cape Coast Ghana.
- Usman, I.A. (2001). The Relationship Between Students Practical Activities and Academic Achievement in Integrated Science at J.S.S. Level using the NISTEP mode of Teaching.
- West African Examination Council (2004). Chief Examiners' Reports Nigeria.
- Wilén, W. & Clegg, A. (1986). Effective Questions and Questioning: A Research Review. Theory and Research in Social Education, 14(2), Pp 153 -61.
- Wilén, W. (1991). Questioning Skills for Teachers. What Research Says to the Teacher (3<sup>rd</sup> ed). Washington, S.D: National Education Association (ED 332 983).
- Winne, P.H. (2007). "Experiments Relating Teachings" Use of Higher Cognitive Questions to Student Achievement." Review of Educational Research 39, 13–50
- Wood, E. (1990). Student/Teacher Achievement Ratio (STAR). Tennessee's K-3 Class-size Study. Final Summary Report 1985-1990. ERIC Document Reproduction Service No. ED 3200692.
- Gender Equity in Science Education. Position Statement from the National Science Teachers Association Supporting Gender Equality in the Classroom. [\(2006\)](http://www.grnderequity-conucil.org).
- Yoloye, A. (1994). International Strategies in Promoting Women Participation in Science and Technology. In Erinosh, S.Y. (Ed) Perspective on Women in Science and Technology in Nigeria – Ibadan. Sam Bookman Education and Communication Service pp 78-95.

## APPENDIX A

Effects of teacher's cognitive questioning style on academic achievement of junior secondary school students in integrated science in Zaria metropolis of Kaduna State.

Students integrated science achievement test (ISAT)

### SECTION A:

Name of School: .....

Class:.....

Sex:            Male                                      Female   

Age:.....

### SECTION B:

Achievement Test

#### Instructions:

- (i) Answer all the questions
- (ii) Each question is followed by four options lettered A to D. Find out the correct option for each question and shade in pencil on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only one answer to each question.

1. Which of the following explanation is correct of frictional force?
  - (a) the smoother the two surfaces are, the less the frictional force between them.
  - (b) the smoother the two surfaces are, the more the frictional force between them.
  - (c) the rougher the two surfaces are, the easier the movement between moving parts.
  - (d) The rougher the two surfaces are, the less the frictional force will be between them.
2. The importance of regular lubrication of machine is explained as:
  - (a) to promote friction
  - (b) to promote rusting
  - (c) to promote wearing away of moving parts
  - (d) to reduce friction and prevent wear of moving parts.

3. A force is needed to
  - (a) make objects move
  - (b) make objects change their direction of motion
  - (c) make objects slow
  - (d) all of the above is correct about a force
4. A process by which green plants manufacture organic food substance from carbon (IV) oxide and water using sunlight energy is called.....
  - (a) chloroplast
  - (b) photosynthesis
  - (c) nutrition
  - (d) growth
5. The transfer of energy through organisms in the community is called a
  - (a) food chain
  - (b) food web
  - (c) consumer
  - (d) decomposer
6. which of the following explain how friction can be reduced between two moving surfaces?
  - (a) constant washing of both surfaces with water
  - (b) rusting of both surfaces
  - (c) constant application of grease to both surfaces
  - (d) exposing both surfaces to excessive heat
7. Energy is the ability to do work. In the process of food manufacture by plants, work is done. What is the source of energy?
  - (a) air
  - (b) carbon (iv) oxide
  - (c) sun
  - (d) star
8. The ability of an organism in a habitat to cope and survive the environment is called.....
  - (a) acculturation
  - (b) naturalization
  - (c) adaptation
  - (d) integration
9. Our forests can be preserved by
  - (a) deforestation
  - (b) replanting our forest
  - (c) having a thorough knowledge of wind direction
  - (d) using firewood for cooking
10. Which of the following description explained how man destroys the natural balance?
  - (a) through various activities such as agriculture, industrialization, development of towns and cities
  - (b) through reforestation, preserving forests, establishing parks and game reserves

- (c) peaceful co-existence of man and proper management of natural resources
  - (d) formation of laws against bush burning, hunting and indiscriminate falling down of trees.
11. A certain machine is used to raise a load by means of smaller effort or by allowing the pull to take place in a more convenient direction. The above description is true of
- (a) lever (b) inclined plane (c) pulley system (d) screw
12. Which type of machine will you use to lift a drum of palm oil into a lorry?
- (a) wheel and axle (b) levers (c) pulley system (d) inclined plane
13. The difference between community and habitat is
- (a) community is the living component of a habitat while habitat is the area inhabited by the living community.
  - (b) Community is the area inhabited by the living habitat while a habitat is the living component of the community.
  - (c) Community is the non-living component of a habitat while habitat is the area inhabited by the non-living community.
  - (d) Community is a settlement while habitat is not.
14. Population can be distinguished from a community in which of the following?
- (a) population comprises of different communities while community is a group of similar population.
  - (b) population is a group of similar population while community comprises of different populations.
  - (c) Population is a living organism while community is a non-living organism
  - (d) Community is just part of a population.
15. The disappearance of some plants and animals from the face of the earth is called.....
- (a) conservation (b) reservation (c) extinction (d) adaptation
16. Organisms obtain their energy through food. All organisms do not produce their food. Only green plants produce their food by using light energy with CO<sub>2</sub> and H<sub>2</sub>O from the environment. From the above explanation, which of the following is the ultimate source of energy for all life in all communities in the biosphere?
- (a) green plants (b) water (c) sun (d) CO<sub>2</sub>

17. The relationship between photosynthesis and respiration is explained as
- during photosynthesis oxygen is produced which is used for respiration by animals and carbondioxide produced during respiration is used for photosynthesis by green plants.
  - during photosynthesis carbondioxide is produced which is used for respiration by animals and oxygen produced during respiration is used for photosynthesis by plants.
  - Both processes are carried out by animals
  - Both processes are anabolic.
18. Balance in nature can be explained to be a community where the number of each population remains about the same from year to year. Which of the following factors are responsible?
- continuous availability of food, good health and absence of natural enemies.
  - increase and decrease in food availability, absence and presence of natural enemies, absence and presence of diseases.
  - continuous food shortage, presence of natural enemies, presence of diseases.
  - nothing changes in the environment from year to year.`
19. In any community, the producers will be far more numerous than the consumers. Thus, there is more grass than grasshoppers and there are more grasshoppers than lizards which eat them, and there are more lizards than snakes that eat them. there if therefore a decreasing number of consumers in a food chain. The above explanation best describe what is called a .....
- pyramid of food
  - pyramid of numbers
  - pyramid of mass
  - pyramid of energy
20. In Africa and some other parts of the world there are game reserves and national parks. These are places where animals are allowed to live in their natural environment without being hunted by everybody. From the above explanation which does not describe a reason for keeping game reserves.
- they give scientific opportunity to know more about wildlife

- (b) animals to be studied are kept in their environment
  - (c) it ensures continuity for such species of animals
  - (d) it provides opportunity for children to go and play with them.
21. Which of the following constructively represent a simple food chain of a school compound?
- (a) Grass → Chicken → Lion
  - (b) Grass → Goat → Man
  - (c) Grass → Elephant → Lion
  - (d) Grass → Antelope → Tiger
22. There are laws in various countries to protect wildlife and other natural resources. One as a law abiding citizen should observed and practice some of these conservation laws so that everybody can enjoy and appreciate the beautiful things in nature in his area. The above explanation is one the methods of
- (a) preservation of wildlife resources
  - (b) coordination of wildlife resources
  - (c) hunting of wildlife resources
  - (d) conservation of wildlife resources
23. Which of the following group of words best compile or explain what ecology means?
- (a) inter-relational study between organisms and their natural environment, between living and non-living things concerning populations and communities
  - (b) study of weather, plants and animals alone
  - (c) study of food chain, food webs and pyramid of mass and numbers
  - (d) evolutionary study of the environment
24. Keeping Game Reserves compose and entails
- (a) protecting, control, safety, security, conserving and ensuring continuity of plants and animal species in their natural habitat.
  - (b) planning how to hunt and fall down trees for lumbering
  - (c) preservation, aforestation and establishment of zoos for revenue collection
  - (d) beauty of environment, tourism and recreation.
25. Which of the following items would you use in constructing a simple pulley system?
- (a) simple wheel, rope or chain, a frame work, support and an axle
  - (b) block, screw, rubber and framework

- (c) tubes, spring, engine and nut
  - (d) road, table, chain and thread.
26. It is a justifiable fact that energy travels in the community in the form of food chain. This is because the received energy from the sun is passed through living organisms in the form of
- (a) light energy food
  - (b) chemical energy of food
  - (c) kinetic energy of food
  - (d) potential energy of food
27. Some animals and plants are today disappearing from the face of the earth. Which of the following best justify the above explanation?
- (a) some plants and animals no longer reproduce their young ones for fear of predators
  - (b) some animal and plants are tired of this world
  - (c) some animals and plants no longer desire to live on earth.
  - (d) hunting, forest destruction, bush burning are indiscriminately practiced extensively.
28. Which of the comments below critically explain why green plants are said to be producers in every ecosystem?
- (a) organic food substances which are essential for life can only be synthesized through photosynthesis, the process which is carried out only by green plants.
  - (b) green plants can grow in every ecosystem with or without favourable conditions.
  - (c) green plants uses the process of chemosynthesis to produce organic food substances
  - (d) because green plants are green in colour and can produce flowers
29. Which of the following options best compare and contrast between photosynthesis and respiration?
- (a) though both processes are carried out by plants, however, photosynthesis is a breaking down (catabolism) process while respiration is a building up (anabolism)

- (b) though both processes are carried out by plants, however, photosynthesis is a building up (anabolism) process while respiration is a breaking down (catabolism).
  - (c) though both processes are carried out by animals, however, photosynthesis is a building up (anabolism) process while respiration is a breaking down (catabolism) process.
  - (d) though both processes are carried out by animals, however, photosynthesis is a breaking down (catabolism) process while respiration is a building up (anabolism) process.
30. The similarities between a car and a bicycle can be seen from the fact that both
- (a) are made up of wood and plastic
  - (b) have steering and windscreen
  - (c) have seat belt and wipers
  - (d) are machines, have wheel, tyres and tubes

**APPENDIX B**  
**Integrated science Achievement Test (ISAT)**  
**Objective Answer Sheet**

Name of School:.....

Class:.....

Sex:            Male                              Female       

Age:.....

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

**APPENDIX C**  
**Marking Scheme for ISAT**

**1. A**

**2. D**

**3.D**

**4.B**

**5.A**

**6.C**

**7.C**

**8.C**

**9.B**

**10.A**

**11.C**

**12.D**

**13.A**

**14.B**

**15.C**

**16.C**

**17.A**

**18.B**

**19.B**

**20.D**

**21.B**

**22.D**

**23.A**

**24.A**

**25.A**

**26.B**

**27.D**

**28.A**

**29.A**

**30.D**

**APPENDIX D**  
**LOW-LEVEL QUESTIONS**

**WEEK I**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Force
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: (i) define what a force is (ii) name five different types of force and state what produces them. (iii) give one example each of their uses (iv) state what frictional force is (v) what is the advantage and disadvantage of a frictional force?
<b>Method:</b>	Lecture method
<b>Instructional material:</b>	Plane surfaces e.g a table, a small ball or any round object, block of wood, string etc.
<b>P/Knowledge:</b>	The students have been pushing or pulling some objects in their daily life.
<b>Introduction:</b>	The teacher introduces the lesson by asking students questions based on their previous knowledge e.g (i) What is always necessary in order to move a body? A force (ii) What will be produced to the engine of a care or lorry to move the vehicle?
<b>Presentation:</b>	Teacher explains to students what is a force?
<b>Step I:</b>	Force cause a body at rest to move and motion occurs in the direction of an applied force. Force is necessary to slow down, stop or increase the speed of a moving body. That

force is always measured in Newton. Force can change the direction of motion of a body.

**Step II:**

Teacher will explain to students that force can be a pull or a push and moves in the direction in which the force is applied, it can be gravitational force, magnetic force, wind force and the force of falling water are used to move objects. All these are types of forces and teachers will elaborate more on the type of forces.

**Step III:**

Teacher will explain to students what frictional force is. Frictional force exists between two moving objects which are in contact and it can be reduced by lubrication and by the use of bearings between moving objects. The locking of two surfaces is what causes friction. Friction is present in most moving objects, sometimes friction is an advantage when walking, riding a bicycle or driving a car, but on most occasions, it is a disadvantage in all moving parts of a machine.

Therefore, if two surfaces are smoother the less the frictional force will be between them.

**Evaluation:**

The teacher evaluates the lesson by asking students questions based on what has been taught. E.g What is a force?

- (i) List five different types forces
- (ii) What is a frictional force?
- (iii) Mention three advantages of friction.
- (iv) Name three situations in which force has to be applied to increase speed, slow down or stop a moving object.

**Conclusion:**

Teacher concludes the lesson by allowing students to ask questions if they have any. Summarize the key points and give students notes to copy.

**Assignment:**

List five types of forces and state their uses each.

**Week II:**

**Subject:** Integrated Science

**Class:** JSII

**Sex:** Mixed

**Topic:** Science in the service of the community

**Sub-topic:** Machines

**B/Objectives:** By the end of the lesson the students should be able to:

- (i) define and give examples of simple machines
- (ii) list five different types of simple machines
- (iii) mention the parts of a lever and classify levers
- (iv) state the uses of simple machines
- (v) give an example of a machine which uses the principles of a lever, an inclined plane and a screw.

**Method:** Lecture method

**Instructional materials:** A bottle of soft drink, a bottle opener, a screw, a pair of scissors, a

Piece of leather, a pair of forceps.

**P/Knowledge:** The students have learnt about forces, types of forces and frictional forces.

**Introduction** Introduces the lesson by asking students questions based on their previous lesson e.g what is a force?

Define a frictional force.

State/list five different types of forces.

**Presentation:** Presents the lesson by defining and explain to students a simple machine.

**Step I:** A simple machine can therefore be defined as an object that enables us to do work with minimum effort. Teacher will also ask students to name some other simple machines that are commonly used at home.

**Step II:** Teacher will list and explain to students the major types of simple machine.

1. Levers – is an arrangement which help us in doing certain work with little effort e.g a pair of scissors,
2. Pulley – it is an object with a hole in the centre and a rolling surface around which a string or rope is hanged. The string or rope is hanged. The string or rope is used to pull objects down.
3. Inclined Plane – it is an arrangement whereby a piece of flat object is placed in a slanting position as a track for the movement of load.
4. Wheel and axle – this simple machine has two components parts, a round wheel and a handle or axle for turning the wheel e.g. windlass.
5. Screw – this is shaped like a nail with grooves or holes going down it, in a curved pattern.
6. Wedge – this is a double inclined plane, shaped like a V on a solid piece of object.

### **Step III**

The teacher will also explain to students parts of a lever and its classes.. A lever has three main parts. These are load end, the effort end and pivot or fulcrum and show a chart to students the parts of a lever. Teacher will also explain to students the three classes of lever, first, second and third. The classification is based on the locations of the load (L), Fulcrum (F) and the effort (E) First class level – has load and effort at the edges and fulcrum in between. Examples are pair of scissors, pliers.

- (i) Second class lever – has effort and the fulcrum at the ends and the load in between. Examples are bottle opener, wheel barrow.
- (ii) Third class level – has the load and fulcrum at the end and effort in between. Examples are pair of forceps and sugar tongs.

### **Evaluation:**

Evaluates the lesson by asking students questions based on what has been taught e.g.

- (i) define a simple machine
- (ii) list the major types of simple machines
- (iii) give three classes of a lever
- (iv) mention the parts of a lever
- (v) give three examples of a first class lever
- (vi) give an example of a machine which uses the principles of a lever, an inclined plane and screw.

**Conclusion:** Concludes the lesson by allowing students to ask questions. Summarize the key points and give students notes to copy.

**Assignment:** With the aid of sketches, define what is meant by first class lever, second class and third class levers.

### **Week III**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Use of Energy and Material in the community
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: (i) define a biological community (ii) define a habitat (iii) what is the source of energy in the community? (iv) State what is an ecological system (v) what is biosphere?
<b>Method:</b>	Lecture method
<b>Instructional materials:</b>	A chart with biological communities
<b>P/knowledge:</b>	the students have been living in different environments and communities.
<b>Introduction:</b>	Teacher introduces the lesson by asking questions based on the previous knowledge. E.g i. what are the non-living components of the environment? ii. What are the living components of the environment? iii. The living organisms that inhabit these areas.
<b>Presentation:</b>	teacher presents the lesson by explaining to students what is meant by a biological community.
<b>Step I:</b>	Biological community is made up of all the living populations in a particular habitat. E.g community in the school compound, a forest community etc. a community therefore is the living component of habitat. The habitat is the area inhabited by the living community. The living component in the habitat interacting with each other makes up an ecological system (an ecosystem).

**Step II:** Teacher explain to students that the global ecosystem is called biosphere, which is the place where life can exist. Plants and animals in the community interact and show interdependence. Everything that is required by living organisms in the community is available in the biosphere except energy. All the materials required for life such as water, oxygen, nitrogen, minerals and other nutrients are obtained from the biosphere.

**Step III:** Teacher will also explain to students using some illustration that the most important relationship in the community is the feeding relationship. Organisms obtain their energy through food. All organisms do not produce their food in the presence of light, carbon dioxide and water from their environment. The sun is the source of energy for all life in all communities in the biosphere. This radiant energy can be trapped only by green plants, during photosynthesis. Green plants form the bridge between the non-living and the living world.

**Step IV:** Teacher also explain to students that since green plants produce from inorganic materials like water, CO<sub>2</sub>, minerals they are called primary producers. Without the green plants, life in the community will not exist or continue. The food producers are eating by plant eating animals called the herbivores. These primary consumers when dead, becomes food for decomposers such as bacteria and fungi which are called saprovores.

**Evaluation:** Teacher evaluates the lesson by asking questions to students based on what has been taught e.g.

- (i) define a community
- (ii) what is a habitat?
- (iii) what is a biosphere?
- (iv) What is the source of energy for all life in all communities?

(v) What are the secondary consumers?

(vi) What is photosynthesis?

**Conclusion:**

Teacher concludes the lesson by allowing students to ask questions and also summarize the key points and give notes to copy.

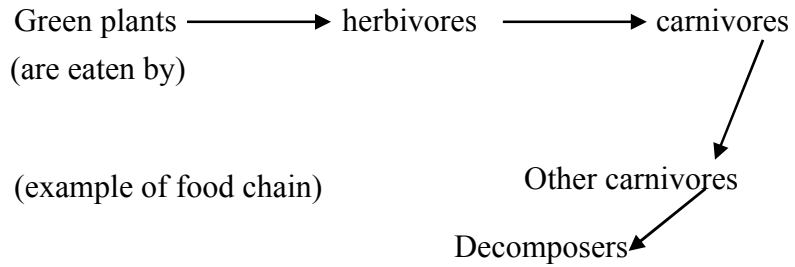
**Assignment:**

Draw a diagram to show the bridge between the non-living and the living world.

#### **Week IV**

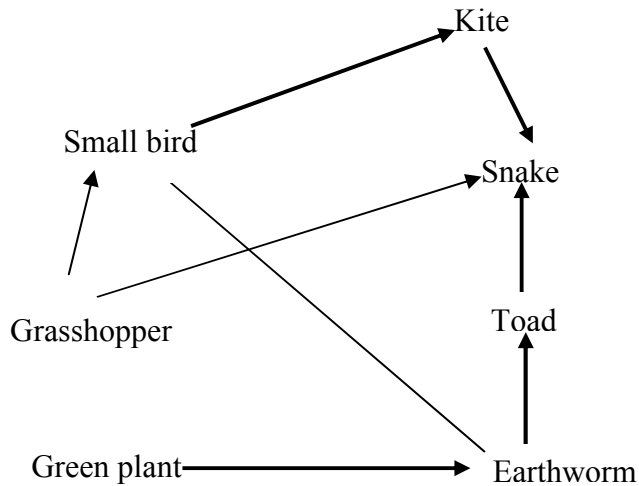
<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Food chain and food web
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: (i) define a food chain (ii) give examples of a simple food chain (iii) list the components that make up a food chain (iv) define a food web (v) list three ecological pyramids (vi) draw the diagram of a trophic level
<b>Method:</b>	Lecture method
<b>Instructional materials:</b>	A chart containing food chain and food web
<b>P/Knowledge:</b>	The students have learnt about the biological community.
<b>Introduction:</b>	Introduces the lesson by asking questions based on the previous lesson e.g (i) what is a community? (ii) what is a habitat? (iii) what is the source of energy for all life in all communities?
<b>Presentation:</b>	Presents the lesson by explaining to students that the energy received from the sun is passed on through living organisms in the community in the form of chemical energy of food.
<b>Step I:</b>	This movement of energy through organism in the community is called a food chain. The components that make up a food chain are primary producer, primary consumer, secondary consumer, tertiary consumer and decomposer. (i) the primary producer is the green plant (ii) the primary consumer is the herbivore

- (iii) the secondary consumer is the carnivore
- (iv) the tertiary consumer is the animal that eat the carnivore.
- (v) The decomposers are the bacteria and fungi.



**Step II:**

Teacher also explains to students a food web. Grass the primary producer may be eaten by different herbivores such as grasshoppers, earthworms, caterpillars, rabbits, cows and others. Likewise primary consumers are preyed upon by different carnivores. Thus you can have many different food chains starting from a producer. This becomes an elaborated network of food chains which we call a food web.

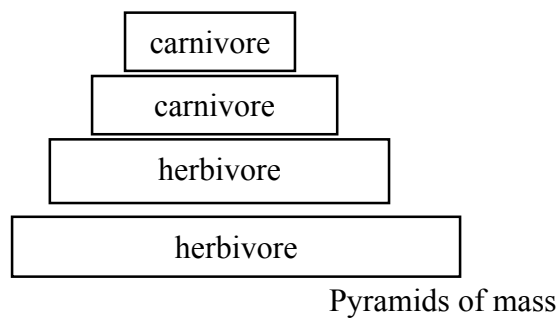


***Example of a food web***

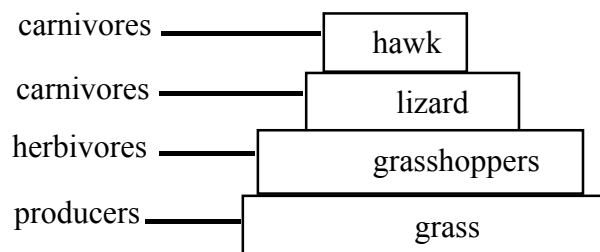
**Step III:**

Teacher will explain to students about pyramids of energy, mass and numbers. The sun is the source of energy in the community and the sun’s radiant energy in the community and the sun’s radiant energy is converted by green plants in the process of photosynthesis, into chemical energy which is stored

in the food. Green plants use part of this energy for their own activities like respiration, growth and reproduction. So the herbivores get less energy than the producers and carnivores get still less energy as part of it is used by herbivores for their own activities. This is called a pyramid of energy. As a result of loss of energy at successive levels, producers have more mass than herbivores, herbivores have more mass than carnivores. This is true of communities that are on land.



In any community, the producers will be far more numerous than the consumers. Thus there is more grass than grasshoppers and there are more grasshoppers than lizards which eat them, and there are more lizards than snakes that eat them. there are therefore, a decreasing number of consumers on a food chain, which is referred to as pyramid of numbers.



Pyramids of number

**Evaluation:**

Evaluates the lesson by asking students questions based on what has been taught e.g

- (i) define a food chain and a food web
- (ii) state the components of a food chain
- (iii) list three ecological pyramids
- (iv) what is the first trophic level in a food chain?

**Conclusion:** Concludes the lesson by allowing student to ask questions and a summary of key points of what has been taught to students and also notes will be given to students for copying.

**Assignment:** Draw the three ecological pyramids and label them.

## **Week V**

**Subject:** integrated Science

**Class:** JSII

**Sex:** Mixed

**Topic:** Science in the service of the community

**Sub-topic:** Maintenance Balance in the Environment

**O/Objectives:** By the end of the lesson the students should be able to:

- (i) define a balance environment
- (ii) what is adaptation?
- (iii) name organisms which are adapted to live in water, on land, in cold surroundings, warm surroundings and in all parts of the world.
- (iv) state the importance of balance in nature.
- (v) give three examples of climax communities.

**P/Knowledge:** The students have learnt about the concept of food chains and food web and ecological pyramids.

**Introduction:** Teacher introduces the lesson by asking students questions based on their previous lesson e.g.

- (i) what is a food chain?
- (ii) list the components of a food chain
- (iii) define an ecological pyramid

**Presentation:** Teacher presents the lesson by explaining to students the need for a balanced environment.

**Step I:** Each kind of organism has structures which make it suitable to live in its own environment. We say that organisms are adapted to live in their own environments. For example a fish is adapted to live in water, bird in air, a frog to live in water and on land. Each living organism carries on its life activities in relation to its, total surroundings. The climates, availability of food, inter-relationship with other forms of life, and many other conditions or factors determine whether one organism or the other can live, grow and

reproduce in an environment. If these factors favour the organism, it will survive and be successful, otherwise it will perish.

**Step II:**

The teacher explain to students' ecological systems we have as forests, grasslands, deserts, lakes, rivers, swamps and the oceans. Animals which are adapted to live in various ecosystems get organized into biological communities. Animal from one community may move to another. As some organism move out, others move in. the biotic community develops through a slow series of changes and adaptations. These changes are also brought about by non-living conditions such as drought, fire, heavy rains and floods. Those are abiotic conditions which may affect the community. When a biotic community after a period of change and development, finally continues with little change for a long period of times, it has reached a state of balance. The community is now called a balanced community or climax community or mature ecosystem.

**Step III:**

Teacher will also explain to students that, in a balanced community, the numbers of each population remain about the same from year to year. The particular organisms found there are the ones which are best adapted to that environment. Because producers are plentiful in a balanced community, herbivores may increase in numbers. This increased number of herbivores provides food for the carnivores, so their numbers increase. But as the large number of carnivores eat the herbivores, herbivore become scarce.

With fewer herbivores for food, the carnivores starve and their numbers are in turn controlled and thus, a balance in numbers of animals is reached. Many animals produce fewer babies when living conditions become difficult. This lower rate of reproduction brings them into balance with their food supply. Diseases also limit the

number of surviving organism as many die off and balance in number is restored. In a mature ecosystem, the numbers of a given kind of population increases, only to be decreased again by natural enemies, lack of food, diseases and death.

**Evaluation:** Teacher evaluates the lesson by asking questions based on what has been taught.

- (i) what do you understand by the term adaptation?
- (ii) List some organisms which are adapted to live in water, in air, on land.
- (iii) What are the factors that favour organism to live in an environment?
- (iv) give three examples of a mature ecosystem
- (v) what are the factors that decreases the population of mature ecosystem?

**Conclusion** Teacher concludes the lesson by allowing students to ask question, gives a summary of the key points and give students notes to copy.

**Assignment:** Mention some factors that influence populations in communities.

## **Week VI**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Wildlife conservation
<b>B/Objective</b>	By the end of the lesson the students should be able to: (i) define wildlife (ii) give examples of ways of conserving wildlife (iii) what is extinction? (iv) mention two activities of man that brought changes in the ecosystems. (v) List two reserves in Nigeria
<b>P/Knowledge:</b>	Students have learnt about the adaptations of organisms in balance environment. Teacher introduces the lesson by asking questions based on their previous lesson. (i) what are the factors that favour an organism to live in an environment? (ii) what are ecological ecosystems?
<b>Presentation:</b>	Teacher presents the lesson by explaining to students, to survive man has always made use of his environment.
<b>Step I:</b>	Man has used some ways to change ecosystems. Man has change existing ecosystems by the development of Agriculture. Increased his food supply by farming. It has also adversely affected soil and wildlife. The development of cities and towns has brought with it slums, overcrowdings, industrialization and population. The destruction of forest makes many animals homeless and the killing of too many lives leads to extinction. The enormous increase in human population explosion has brought about famine, pollution and sickness and hence an imbalance in the ecosystem.

**Step II:**

Teacher will also explain to students that man has been putting in great efforts to preserve as much of the natural ecosystems as possible. National parks, wildlife reserves and gardens are established. Reforestation programmes have been promoted to protect plants and animals. The way people go about hunting these animals, some of them are in danger of becoming extinct. Young and pregnant females are killed thereby indirectly killing the young ones, so that there is no way of continuing the species. Man must learn to conserve the soil, forest water and animals in order to maintain the normal ecological balance. When you cut down trees for farming and other purposes you destroy the forest where the animals live (natural habitat). Some of them move away and adapt to new environment. Others cannot survive in new environments so they die off.

**Step III:**

Teacher explains to students' ways by which wildlife can be conserved. National Parks and Games Reserves are large areas of land where large numbers of wild animals live in their natural surroundings or habitat. No hunting and farming are allowed in these areas. These Parks and Reserves protect and conserve wild animals, including rare animals which may have become extinct. These Parks attract tourists to come and see animals. Scientists come to study animals, their ways of life and behavior. These places help to promote scientific research. Much needed natural shelter and cover is provided for animals by these wild forest area. Tourist bring foreign exchange, which helps the national economy. It is very necessary for man to use his natural wealth or resources wisely, keeping in mind the need for future generations. The wise use of resources is called conservation. We should try to conserve our wildlife, the water, soil and the minerals.

**Evaluation:**

Teacher evaluates the lesson by asking students questions based on what has been taught.

- (i) what is wildlife?
- (ii) what is extinctions?
- (iii) what is extinction?
- (iv) What are the conditions that effect organism in their environment.
- (v) List activities of man that destroy the natural balance
- (vi) Mention some ways by which man's activities helps in maintaining balance in the environment.

**Conclusion**

Teacher concludes the lesson by allowing students to ask questions, summarizes the key points and give students notes to copy.

**Assignment:**

Name some National Parks and Game Reserves you know in Nigeria.

**APPENDIX E**  
**HIGH-LEVEL QUESTIONS**

**WEEK I**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Force
<b>B/Objective:</b>	By the end of the lesson the students should be able to: (i) Describe an experiment to show how force changes the direction of motion of a body. (ii) Describe three situations in which friction is an advantage (iii) Describe two ways of reducing friction between two moving surfaces (iv) Explain how lubricants and bearings help in reducing friction. (v) Outline five types of forces and explain each.
<b>Method:</b>	Lecture method
<b>Insturc/Materials</b>	Block of wood, string, a table, a small ball or any round object.
<b>P/Knowledge:</b>	Teacher introduces the lesson by asking students questions based on their previous knowledge e.g. (i) Describe what always move a body (ii) What changes the direction of motion of body?
<b>Introduction:</b>	Teacher introduces the lesson by asking students questions based on their previous knowledge e.g (i) Describe what always move a body (ii) What changes the direction of a body?
<b>Presentation:</b>	Teacher explains to students what is a force?

**Step I** Force cause a body at rest to move and motion occurs in the direction of an applied force. Force is necessary to slow down, stop or increase the speed of a moving body. The force is always measured in Newton. Force can change the direction of motion of a body.

**Step II:** Teacher will explain to students that force can be a pull or a push and moves in the direction in which the force is applied, it can be gravitational force, magnetic force, wind force and the force of falling water are used to move objects. All these are types of forces and teacher will elaborate more on the type of forces.

**Step III:** Teacher will explain to students what frictional force is. Frictional force exists between two moving objects which are in contact and it can be reduced by lubrication and by the use of bearings between moving objects. The locking of two surfaces is what causes friction. Friction is present in most moving object, sometimes friction is an advantage when walking, riding a bicycle or driving a car, but on most occasions, it is a disadvantage in all moving parts of a machine.

Therefore, if two surfaces are smoother the less the frictional force will be between them.

**Evaluation:** The teacher evaluates the lesson by asking students questions based on what has been taught. E.g.

- (i) Outline the different types of forces and explain each.
- (ii) Distinguish between a force and a frictional force.
- (iii) Describe three situations in which friction in an advantage.

- (iv) Describe three situations in which friction is a disadvantage and explain in each case how it can be reduced.
- (v) Explain why the regular lubrication of a machine is very important.

**Conclusion**

Teacher conclude the lesson by allowing students to ask questions, summarize the key points and give them notes to copy.

**Assignment:**

Explain five types of forces and state their uses each.

## WEEK II

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Machines
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: (i) Draw a sketch of a simple machine and explain the load, effort and fulcrum. (ii) Describe different types of simple machines. (iii) Why do you think that the inclined plane is a machine? (iv) Explain with aid of sketches, what is meant by lever of: (a) the first class (b) second class (c) third class
<b>Method:</b>	Lecture method
<b>Instructional materials</b>	Bottle of soft drink, bottle opener, a screw, pair of scissor, piece of leather etc.
<b>P/Knowledge:</b>	The students have learnt about forces, types of forces and frictional forces.
<b>Introduction:</b>	teacher introduces the lesson by asking students questions based on their previous lesson e.g. (i) Explain what is meant by a force (ii) Explain a frictional force
<b>Presentation:</b>	Presents the lesson by defining and explain to student a simple machine.
<b>Step I:</b>	A simple machine can therefore be defined as an object that enables us to do work with minimum effort. Teacher will

also ask students to name some other simple machines that are commonly used at home.

**Step II:**

Teacher will list and explain to students the major types of simple machines.

1. Levers – is an arrangement which help us in doing certain work with little effort e.g. a pair of scissor, a wheel barrow, a nut cracker, a hammer etc.
2. Pulley – it is an object with a hole in the centre and a rolling surface around which a string or rope is hanged. The string or rope is used to pull objects down.
3. Inclined Plane – it is an arrangement whereby a piece of flat object is placed in a slanting position as a track for the movement of the load.
4. Wheel and axle – this simple machine has two components parts, a round wheel and a handle or axle for turning the wheel e.g. windlass.
5. Screw – this is shaped like a nail with grooves or holes going down it, in a curved pattern.
6. Wedge – this is a double inclined plane, shaped like a V on a solid piece of object.

**Step III:**

The teacher will also explain to students parts of a lever and its classes. A lever has three main parts. These are load end, the effort end and the pivot or fulcrum and show a chart to students the parts of a lever. Teacher will also explain to students the three classes of lever, first, second and third. The classification is based on the locations of the load (L), Fulcrum (F) and the Effort (E).

- (iv) first class lever – has load and effort at the edges and fulcrum in between. Examples are pair of scissors, pliers.

- (v) Second class lever – has effort and the fulcrum at the ends and the load in between. Examples are bottle opener, wheel barrow.
- (vi) Third class lever – has the load and fulcrum at the end and effort in between. Examples are pair of forceps and sugar tongs.

**Evaluation:**

Evaluates the lesson by asking students questions based on what has been taught e.g.

- (i) Explain what is meant by the term pulley system.
- (ii) Describe the structure of first, second and third class levels.
- (iii) Differentiate between a pulley system and an inclined plane.
- (iv) Compare and contrast between first class lever and a second class lever.
- (v) Differentiates between a second class lever and a third class lever.

**Conclusion:**

Concludes the lesson by allowing students to ask questions. Summarize the key points and give them notes to copy.

**Assignment:**

With the aid of sketches, explain what is meant by first class lever, second class and third class levers.

### **WEEK III**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Use of Energy and Material in the community
<b>O/Objectives:</b>	By the end of the lesson the students should be able to: (i) Differentiates between a community and a habitat. (ii) Explain the differences between a population and a community. (iii) Construct a simple food chain of the school compound. (iv) Explain the relationship between photosynthesis and respiration.
<b>Method:</b>	Lecture method
<b>Instructional materials</b>	A chart with biological communities
<b>P/Knowledge:</b>	The students have been living in different environments and communities.
<b>Introduction:</b>	Teacher introduces the lesson by asking questions based on what has been taught. E.g. (i) What are the living components of the environment (ii) What are the non-living components of the environment?
<b>Presentation:</b>	Teachers presents the lesson by explaining to students what is meant by a biological community.
<b>Step I:</b>	Biological community is made of all the living populations in a particular habitat. E.g community in the school compound, a forest community of a habitat. The habitat is the area inhabited by the living community. The living component in the habitat interacting with each others makes up an ecological system (an ecosystem)

**Step II:** Teacher explains to students that the global ecosystem is called biosphere, which is the place where life can exist. Plants and animals in the community interact and show interdependence. Everything that is required by living organisms in the community is available in the biosphere except energy. All the materials required for life such as water, oxygen, nitrogen, minerals and other nutrients are obtained from the biosphere.

**Step III:** Teacher will also explain to students using some illustration that the most important relationship in the community is the feeding relationship. Organisms obtain their energy through food. All organisms do not produce their food in the presence of light, carbon dioxide and water from their environment. The sun is the source of energy for all life in all communities in the biosphere. This radiant energy can be trapped only by green plants, during photosynthesis. Green plants form the bridge between the non-living and the living world.

**Step IV:** Teacher also explain to students that since green plants produce from inorganic materials like water, CO<sub>2</sub>, minerals they are called primary producers. Without the green plants, life in the community will not exist or continue. The food producers are eaten by plant eating animals called the herbivores. These primary consumers when dead, becomes food for decomposers such as bacteria and fungi which are called saprovores.

**Evaluation:** Teacher evaluates the lesson by asking students questions based on what has been taught e.g.

- (i) Differentiates between a habitat and a community
- (ii) Differentiates between a primary consumer and a secondary consumer.

- (iii) Explain what is meant by ecological system.
- (iv) Describe the source of energy for all life in all communities.
- (v) Explain the differences between a population and a community.

**Conclusion:**

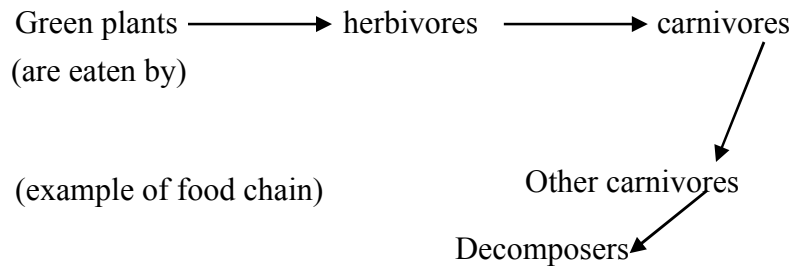
Teacher concludes the lesson by allowing students to ask question if they have any. Summarize the key points and give notes to copy.

**Assignment:**

With the aid of a diagram explain the bridge between the no-living and the living world.

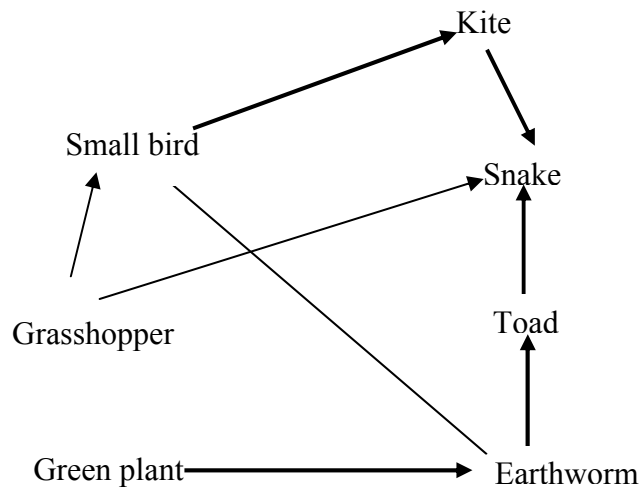
## WEEK IV

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Food chain and food web
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: (i) Describe the components of a food chain. (ii) Construct a simple food chain of a school compound including you as one of the links in each. (iii) Compare and contrast between pyramid of energy and pyramid of numbers. (iv) Construct a food web found in the school compound.
<b>Method:</b>	Lecture method
<b>Instructional materials</b>	A chart containing food chain and food web
<b>P/Knowledge:</b>	The students have learnt about the biological community.
<b>Presentation:</b>	Presents the lesson by explaining to students that the energy received from the sun is passed on through living organisms in the community in the form of chemical energy of food.
<b>Step I:</b>	This movement of energy through organisms in the community is called a food chain. The components that make up a food chain are primary producer, primary consumer, secondary consumer, tertiary consumer and decomposer. (i) the primary producer is the green plant (ii) the primary consumer is the herbivore (iii) the secondary consumer is the carnivore (iv) the tertiary consumer is the animal that eat the carnivore. (v) the decomposers are the bacteria and fungi.



**Step II:**

Teacher also explains to students a food web. Grass the primary producer may be eaten by different herbivores such as grasshoppers, earthworms, caterpillars, rabbits, cows and others. Likewise primary consumers are preyed upon by different carnivores. Thus you can have many different food chains starting from a producer. This becomes an elaborated network of food chains which we call a food web.

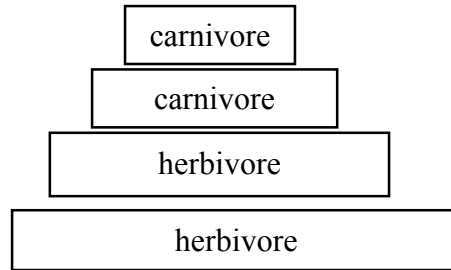


***Example of a food web***

**Step III:**

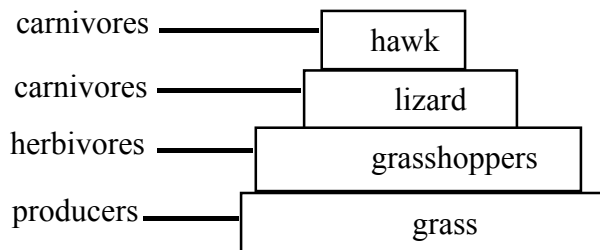
teacher will explain to students about pyramids of energy, mass and numbers. The sun is the source of energy in the community and the sun's radiant energy is converted by green plants in the process of photosynthesis, into chemical energy which is stored in the food. Green plants use part of this energy for their own activities like respiration, growth and reproduction. So the herbivores get less energy than the producers and carnivores get still

less energy as part of it is used by herbivores for their own activities. This is called a pyramid of energy. As a result of loss of energy at successive levels, producers have more mass than herbivores, herbivores have more mass than carnivores. This is true of communities that are on land.



Pyramids of mass

In any community, the producers will be far more numerous than the consumers. Thus there is more grass than grasshoppers and there are more grasshoppers than lizards which eat them, and there are more lizards than snakes that eat them. there are therefore, a decreasing number of consumers on a food chain, which is referred to as pyramid of numbers.



Pyramids of number

**Evaluation:**

evaluates the lesson by asking students questions based on what has been taught e.g

- (i) Describe the three ecological pyramids

- (ii) Construct a simple food chain of a pond.
- (iii) Explain what is meant by a food web
- (iv) Construct a food web of a school compound
- (v) List and explain the components of a food chain
- (vi) Draw and describe the difference between a pyramid of mass and pyramid of numbers.

**Conclusion:**

Concludes the lesson by allowing students to ask questions, summary the key points and give students notes to copy.

**Assignment:**

Draw and explain the three ecological pyramids and label them.

## **WEEK V**

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Maintenance Balance in the Environment
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: a. Explain what is meant by adaptation. b. Describe and explain organisms which are adapted to live in water, on land, in cold surroundings and warm surroundings. c. Explain what is meant by a balanced community. d. Outline and describe the factors which favour organisms to live in an environment.
<b>P/knowledge:</b>	The students have learn about the concept of food chains and food web.
<b>Introduction:</b>	Teacher introduces the lesson by asking students questions based on what has been taught previously e.g. (i) Enumerate and explain the components of a food chain. (ii) Outline and describe the three ecological pyramids
<b>Presentation:</b>	Teacher presents the lesson by explaining to students the need for a balanced environment.
<b>Step I:</b>	Each kind of organism has structures which make it suitable to live in its own environment. We say that organisms are adapted to live in their own environments. For example a fish is adapted to live in water, bird in air, a frog to live in water and on land. Each living organism carries on its life activities in relation to its, total surroundings. The climate, availability of food, interrelationship with other forms of life, and many other conditions or factors determine whether

one organism or the other can live, grow and reproduce in an environment. If these factors favour the organism, it will survive and be successful, otherwise it will perish.

**Step II:**

The teacher explains to students' ecological systems we have as forests, grasslands, deserts, lakes, rivers, swamps and the oceans. Animals which are adapted to live in various ecosystems get organized into biological communities. Animals from one community may move to another. As some organisms move out, others move in. The biotic community develops through a slow series of changes and adaptations. These changes are also brought about by non-living conditions such as drought, fire, heavy rains and floods. These are abiotic conditions which may affect the community. When a biotic community after a period of change and development, finally continues with little change for a long period of time, it has reached a state of balance. The community is now called a balanced community or climax community or mature ecosystem.

**Step III:**

Teacher will also explain to students that, in a balanced community, the numbers of each population remain about the same from year to year. The particular organisms found there are the ones which are best adapted to that environment. Because producers are plentiful in a balanced community, herbivores provide food for the carnivores, so their numbers increase. But as the large number of carnivores eat the herbivores, herbivores become scarce.

With fewer herbivores for food, the carnivores starve and their numbers are in turn controlled and thus, a balance in numbers of animals is reached. Many animals produce fewer babies when living conditions become difficult. This lower rate of reproduction brings them into balance with their food

supply. Diseases also limit the number of surviving organism as many die off and balance in number is restored. In a mature ecosystem, the numbers of a given kind of population increases, only to be decreased again by natural enemies, lack of food, diseases and death.

**Evaluation:**

Teacher evaluates the lesson by asking questions based on what has been taught. E.g

- (i) explain what is meant by balanced community
- (ii) Differentiate between organisms which are adapted to live on land and those adapted to live in air.
- (iii) Explain what is meant by competition in nature.
- (iv) Justify that energy from sunlight is absorbed by green plants during photosynthesis in a balanced community.
- (v) Explain what is meant by balance in nature. How does the killing of lizards, for example, upset the balance in the community?

**Conclusion:**

Teacher concludes the lesson by allowing students to ask questions, summarize of the key points and give students notes to copy.

**Assignment:**

explain the factors that influence populations in communities.

## WEEK VI

<b>Subject:</b>	Integrated Science
<b>Class:</b>	JSSII
<b>Sex:</b>	Mixed
<b>Topic:</b>	Science in the service of the community
<b>Sub-topic:</b>	Food chain and food web
<b>B/Objectives:</b>	By the end of the lesson the students should be able to: <ol style="list-style-type: none"><li>Explain what is meant by the term wildlife.</li><li>Describe some ways by which man changes his environment.</li><li>Describe some ways of protecting and preserving wildlife.</li><li>Write a small paragraph about a National Park or Game Reserve.</li><li>Compare and contrast between extinction and maintenance in a balanced community.</li></ol>
<b>P/Knowledge:</b>	Students have learn about the adaptations and maintenance in a balanced community.
<b>Introduction:</b>	Teacher introduces the lesson by asking students questions based on their previous lesson. <ol style="list-style-type: none"><li>Describe some factors that favour an organism to live in an environment.</li><li>Explain a mature ecosystem.</li></ol>
<b>Presentation:</b>	Teacher presents the lesson by explaining to students, to survive man has always made use of his environment.
<b>Step I:</b>	Man has used some ways to change ecosystems. Man has changed existing ecosystems by the development of Agriculture. Increased his food supply by farming. It has also adversely affected soil and wildlife. The development of cities and towns has brought with it slums, overcrowdings, industrialization and pollution. The destruction of forest

makes many animals homeless and the killing of too many lives leads to extinction. The enormous increase in human population explosion has brought about famine, pollution and sickness and hence an imbalance in the ecosystem.

**Step II:**

Teacher will also explain to students that man has been putting in great efforts to preserve as much of the natural ecosystems as possible. National parks, wildlife reserves and gardens are established. Reforestation programmes have been promoted to protect plants and animals. The way people go about hunting these animals, some of them are in danger of becoming extinct. Young and pregnant females are killed thereby indirectly killing the young ones, so that there is no way of continuing the species. Man must learn to conserve the soil, forest water and animals in order to maintain the normal ecological balance. When you cut down trees for farming and other purposes you destroy the forest where the animals live (Natural habitat). Some of them move away and adapt to new environment. Others cannot survive in new environments so they die off.

**Step III:**

Teacher explains to students' ways by which wildlife can be conserve. National Parks and Games Reserves are large areas of land where large numbers of wild animals live in their natural surroundings of habitat. No hunting and farming are allowed in these areas. These Parks and Reserves protect and conserve wild animals, including rare animals which may have become extinct. These Parks attract tourists to come and see animals. Scientists come to study animals, their ways of life and behaviour. These places help to promote scientific research. Much needed natural shelter and cover is provided for animals by these wild forest area. Tourist brings foreign exchange, which helps the national

economy. It is very necessary for man to use his natural wealth or resources wisely, keeping in mind the need for future generations. The wise use of resources is called conservation. We should try to conserve our wildlife, the water, soil and the minerals.

**Evaluation:**

Teacher evaluates the lesson by asking students questions based on what has been taught.

- (i) Describe some ways by which the activities of man destroy the natural balance
- (ii) Justify the means that man's activities help in maintaining balance in the environment.
- (iii) Describe some ways of protecting and preserving wildlife.
- (iv) Explain what is meant by conservation of natural resources.
- (v) Write a small paragraph about a National Park or Game Reserve.

**Conclusion:**

Teacher concludes the lesson by allowing students to ask question, summarize the key points and gives students notes to copy.

**Assignment:**

Write a short paragraph about National Park and Game Reserves you know in Nigeria.

## APPENDIX F

**Table of Specification for Item Distribution**

	<b>Domain (levels)</b>	<b>No. of Items</b>
1.	Knowledge	5
2	Comprehension	5
3	Application	5
4	Analysis	5
5.	Synthesis	5
6	Evaluation	5

## APPENDIX G

**Table of Specification for Content Taught in the Study**

	<b>Topics</b>	<b>Multiple choice test</b>
1	Force	1,3,6
2	Machine	2,11,12,25,30
3	Use of energy and material in the environment	4,7,13,14,16,17, 23
4	Food chain and food web	5,19,21,26,28,29
5	Maintenance balance in the environment	8,9,10,18
6	Wild life conservation	15,20,22,24,27

## APPENDIX H

### Formula for Facility Indices (FI)

$$FI = \frac{R}{T}$$

Where FI = Facility Index

R = Number of correct responses

T = Total number of students

## APPENDIX I

### Formula for Discrimination Indices (DI)

$$d = \frac{R_u - R_l}{\frac{1}{2} N}$$

Obtained by the top 27% and bottom 27% of the test, it is

Where d = Discrimination Indices

$R_u$  = Number among upper 27% of respondents

$R_l$  = Number among lower 20% of respondents

N = Total number of respondents

**APPENDIX J**  
**Reliability of the Instrument**

**Correlations**

		FISTEST	SECOTEST
FISTEST	Pearson Correlation	1	-.028
	Sig. (2-tailed)		.848
	N	50	50
SECOTEST	Pearson Correlation	-.028	1
	Sig. (2-tailed)	.848	
	N	50	50