"THE RELATIONSHIP BETWEEN STUDENTS' PERFORMANCE IN PRATICAL ACTIVITIES AND THEIR ACADEMIC ACHIEVEMENT IN INTEGRATED SCIENCE USING NISTEP MODE OF TEACHING"

BY

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DECLARATION

I hereby declare that the work presented in this dissertation for the degree of Doctor of Philosophy (Ph.D) in Science Education has not been presented either wholly or partially for any degree and is not being concurrently submitted for any other degree.

The work is entirely the result of independent investigation. The various sources to which I am indebted are duly acknowledge and indicated in the citation made in the section titled REFERENCES.

USMAN, ISA ALHAJI

CERTIFICATION

This dissertation titled THE RELATIONSHIP BETWEEN STUDENTS' PERFORMANCE IN PRACTICAL ACTIVITIES AND THEIR ACADEMIC ACHIEVEMENT IN INTEGRATED SCIENCE USING NISTEP MODE OF TEACHING by USMAN ISA ALHAJI meets the regulation governing the award of the degree of Doctor of Philosophy (Ph.D) in Science education of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to

My father

Alhaji Shittu Usman

My Mother

Hajiya Raliya Shittu

My wife

Hajiya Fatima Isa Usman

And my Children;

Rilwantu, Halima, Shittu, Hamidat and Yusuf.

I LOVE YOU ALL

ABSTRACT

The quest for the improvement of students' performance in practical activity and their achievement and the relationship between the two, in integrated science at the Junior Secondary School (JSS) level prompted the need for this study. The intent of the study, therefore, was to examine the relationship between students' performance in practical activity and their academic achievement in integrated science using NISTEP mode of teaching.

Six research questions were formulated and six null hypotheses were stated and tested to answer the research questions.

Test of Integrated Science Practical Skills (TOISPS) and Integrated Science Achievement. Test (ISAT) were used to collect data from 100 subjects in the Junior Secondary School Classes III. the Pearson product moment correlation coefficient (r) statistics was used to test for the relationship while t-test statistics was used to test for the significance of the difference between the mean scores of the subjects at 0.05 level of confidence. From analysis of data the following findings were reached.

1 There was high positive relationship between students' performance in practical activity and their academic achievement in integrated science when exposed to NISTEP mode of teaching.

2 Male students' performance in practical activity is related to their academic achievement in integrated science when exposed to NISTEP mode of teaching.

3 There was high positive relationship between female students' performance in practical activity and their academic achievement in integrated science when exposed to NISTEP mode of teaching.

4 Students' exposed to NISTEP mode of teaching performed better in academic achievement integrated science than those taught with lecture method.

5 There was no significant differences in mean scores the performances of male and female students in practical activities in integrated science when exposed to NISTEP mode of teaching.

6 Male and female students exposed to NISTEP mode of teaching do not differ significantly in their academic achievement in integrated science.

From the findings of this study, it was concluded that students' performance in practical activities and their academic achievement are significantly related positively when NISTEP mode of teaching is used in integrated science teaching at Junior Secondary School level.

NISTEP mode of teaching enhances students' performance in practical activities and their academic achievement in integrated science or Junior Secondary School level.

NISTEP mode of teaching is also gender – friendly. It enhances both, male and female students' performance in practical activities and their academic achievement in integrated science at Junior Secondary School level.

Recommendation were made, on the use of NISTEP mode of teaching integrated science at Junior Secondary School level based on the findings of the study.

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ABBREVIATION AND DEFINITION OF TERMS

The following operational definitions of terms and abbreviation used for this study are presented for the guidance of the reader.

DEFINITION OF TERMS

1. Practical activity - This is the type of activity or learning experience involving skills which scientists employ when solving science problems.
2. Academic achievement – This is the overall performance of students in a given test after a series of instruction and training.
3. Integrated Science – Is a unified form of science programme in which the boundries between various science disciplines are emphasized in the teaching/learning process.
4. NISTEP Mode of Teaching – Is a variant of activity method of teaching science, sometimes involving paper and pencil or pen activities.

ABBREVIATIONS

AAAS	American Association for the Advancement of Science
CBA	Chemical Bond approach
CESAC	Comparative Education Study and Adaptation Center
ESS	Elementary Science Study
FME	Federal Ministry of Education
ISAT	Integrated Science Achievement Test
JSS	Junior Secondary School
JSTAN	Journal of Science Teachers Association of Nigeria.
NCE	Nigerian Certificate in Education
NPE	National Policy on Education
NISP	Nigeria Integrated Science Project

NISTEP	Nigerian Integrated Science Teacher Education Project
PEIP	Primary Education Improvement Programme
PSSC	Physical Science Study Committee
SAPA	Science – A Process Approach
STAN	Science Teachers Association of Nigeria
TOISPS	Test of Integrated Science Practical Skills
WAEC	West African Examination Council

CHAPTER ONE

THE PROBLEM

1.1 INTRODUCTION

This study investigated the relationship between students' performance in practical activities and their academic achievement in integrated science at Junior secondary school level using NISTEP mode of teaching. In this chapter, the background to the study is described. It includes meaning of practical activities and academic adherent as used in context of this study. Practical activities in the NISTEP mode of teaching are outlined. Also statement of the problem, significance of study, research questions and hypotheses are discussed.

1.2 BACKGROUND TO THE STUDY

The importance of science as requirement for scientific and technological development cannot be over emphasized. Conant (1951) defined science as "an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation". Roberts (1975),as described science, as involving the investigation of natural phenomena through scientific process and attitude so as to produce scientific products. Abdullahi (1982) defined science as " an activity culminating into testable, falsifiable and veritable body of knowledge".

The above definitions show that science is not just a collection of data and facts neither is it an assembly of sterile body of knowledge but that, it involves engaging in certain activities as well.

One of the broad aims of the National Policy on Education (FME 1981) is " To equip students to live effectively in modern age of science and technology.." In line with these objectives, science subjects are among the core subjects that are being taught in secondary schools and also in Nigerian Colleges of Education, Polytechnics and University as well.

According to Abubakar (1972), Oguniyi (1982), and Bajah (1988) Nigeria is in a world where science and technology become an integral part of the world's culture. Any country that overlooks this significant truism does so at the risk of remaining backward in a world that is becoming increasingly sophisticated technologically.

In view of the importance of science generally, tremendous emphasis in science education has been centered on developing teaching strategies which will help to enhance students' understanding of science concepts and acquisition of requisite skills. From the above observation, a science subject requires certain appropriate instructional approaches for a meaningful learning of science. Some of these approaches are; enquiry method, discovery method, process skill approach, activity, to mention but a few. These approaches give provision for manipulation of equipment, acquisition of appropriate scientific skills, meaningful learning and teaching of scientific concepts and principles that can lead to positive scientific and technological development needed in Nigeria as stipulated in the National Policy on Education (FME, 1981).

However, a close look at the way science subjects are taught in Nigeria schools today shows that majority of science teachers use the traditional lecture method approach, Eze (1976), Sorunke (1982), Mari (1994). The results from these studies, for example, show that most ~~sincere~~ science teachers do not encourage students' active participation in the teaching process. There is inadequate

provision of practical activities and those provided are often inappropriate to produce the desired effect. Experiments in science subjects are often demonstrated to students for observation and to copy the notes and diagrams into their notebooks. Effective science teaching and learning should involve students' active participation in the teaching/learning process. Lack of active participation of students is one of the factors responsible for students' poor performance in science subjects (Inyang, 1988; Bichi, 1988).This has also been indicated in WAEC results of secondary schools where students' performances are generally poor in Biology, Chemistry, physics and other science related subjects. This pattern of poor performance in the sciences by students is also observed in the tertiary institutions (Olarinoye, 1978).

From the above discussion, therefore, it is considered important and of interest to determine the relationship, if any, between students' performance in practical activities and their academic achievement in integrated science using NISTEP mode instruction.

1.2.1 NIGERIAN INTEGRATED SCIENCE TEACHER EDUCATION PROJECT (NISTEP)

Integrated science was introduced into Nigerian secondary schools in 1972 at Junior Secondary School level. The course objectives of the integrated programme were clearly spelt out. These objectives could not be achieved due to inadequate teacher preparation to teach the course as observed by Jegede (1983), Bajah (1983), Shuaibu and Ameh (1982), Inyang (1988). Infact, there was little or no teacher preparation since the assumption had been made by science teachers that any science graduate teacher could teach the course. This was shown to be a false assumption in most cases (Mani 1981, Jegede 1983).

the main focus of the integrated science programme by then was on course materials production such as text books. The aspect of teachers' preparation was neglected.

The introduction of the National Policy on Education (FME, 1981), and incorporation of integrated science as core subject over the three years of junior secondary school programme made the issue of teacher preparation for integrated science a national problem. The introduction of NISTEP was an attempt to solve this problem mainly through the double – major integrated science programme and integrated science staff development at NCE level. The staff training was an in service training programme for teacher trainers at NCE level, through series of workshops within and outside the country. The teaching strategy used in training the teachers during the workshops was NISTEP mode of instruction, used as the approach in this study.

NISTEP mode of teaching was designed by Institute of Education, ABU. Zaria, in collaboration with Kings College London in 1992. It is a learner-centered activity method and is comprised of process approach, inquiry method, problem solving, discovery method, and application of science and technology to the teaching of science (NISTEP, 1993).

NISTEP mode of teaching was based on the psychological theories of learning, which emphasized that children learn better by active participation in the teaching/learning process. Brunner (1960), described four major benefits derived by pupils when they learn to investigate and discover for themselves. These are : -

a. There is increase in intellectual potency.

b. There is shift from extrinsic to intrinsic reward.

c. Discovery aids memory processing.

d. The students learn the heuristics of discovery.

Piaget (1977) observed that there will be no true learning unless the child acts upon information and in the process assimilate and accommodate what he encounters with in his environment.

In another dimension Gagne (1967) proposed that teaching science through inquiry-oriented activities makes learning meaningful and aids effective teaching and learning of science. Ausubel (1968) opined that a school child is completely dependent upon current or prior concrete empirical evidence for the meaningful understanding or manipulation of relational proposition. Teaching through the use of activity method allows children to observe, interact, and deduce meaning from learning of given concept, principle or ideas, (Kerr, 1963 and Kempa, 1986). Driver, (1983) also remarked that practical activity in itself is not enough for the teaching and learning of science but the meaning deduced form the results of activity through discussing of the results makes the activity meaningful and aids meaningful teaching and learning of science.

NISTEP mode of teaching takes any of the following forms:

i. Those involving the use of manufactured materials, equipment or apparatus.
ii. Those involving the use of locally available or improvised equipment, material and apparatus.
iii. Those involving the use of paper and pencil and pen;
iv. Those involving the use of discussion in groups or the whole class;
v. Those involving the use of games.
vi. Those involving any combination of the above.

NISTEP mode of teaching uses one or any combination of the above forms of activities. However, not all science topics can be taught using manufactured or locally improvised equipment and material for the following reasons:

a. Cost of the material and equipment
b. Non- availability of materials
c. The nature of the topics.
d. Size of the teaching group

In such a situation as stated above, NISTEP recommends, the use of paper and pencil or pen activities as the solution to the above constraints instead of resorting to the usual lecture method of teaching.

Paper and pencil or pen activities comprise any or a combination of some of the following:

1. The use of diagram, chart, pictograph, graphic, etc to present ideas, topics, principle to the students.
2. Demonstration of some scientific concept, skills, etc for students to discuss the outcome.
3. Use of question and answer in form of brainstorming exercise by students to understand a given topic, idea, concept or principle.
4 Use of discussion on a given topic, idea or principle which may be individual student, group of students or whole class discussion to solve a given problem or to grasp some fundamental concepts, idea or principle, etc.

5 Construction and utilization of some locally made materials, apparatus or equipment to be used during teaching and learning of scientific ideas and scientific skills (Turton,1991).

Practical teaching steps to be used in NISTEP mode of teaching are :

i. Division of students into small groups of 8 – 10.

ii. Brain storming session: where students will be asked some questions or given an assignment on a given topic by the teacher and allowed to answer the question individually in their groups. The students will come up with their answer based on their group members' answers.

iii Presentation of group members' answers for the whole class for discussion.

iv Moderation of group answers by the teacher and pupils to come up with correct answers.

The activities involved in the practical teaching can be summarized as follows:

10 minutes discussion in groups

10 minutes whole class discussion

10 minutes reporting personal observation.

The duration of each step depends on the nature of topics (see appendix A). In the above process, the teacher could introduce concepts, ideas or principles from which he/she wants the pupils to learn, but which they did not mention in their answers. This type of group work as a learning management strategy is desirable in the learning of science because it has the following advantages:

i. Learning form one's peers,

ii Increase of self-confidence and

iii Increase of communication skills

In addition to teaching the process skills of science, it is argued that greater understanding of science will be achieved through methods which involve activities (Turton, 1991). However, the nature of activity to be used needs to be selected with greater care to avoid confusion. NISTEP activity based course materials were drawn taking note of the problems of activity methods of learning science. NISTEP mode of teaching emphasizes process approach, pupil-centered activities, inquiry, problem solving and application of science and technology strategies to the teaching and learning of science.

The NISTEP mode of teaching was adopted for this study . This is because improvisation of materials are not easy to come by and in some topics practical activities are difficult to organize .This method of teaching is of necessity, employed in situations where funds for purchasing materials, and equipment for the teaching and learning of science are inadequate. It is also adopted in situations of non-availability of teaching materials thereby reducing the dependence on the use of lecture method of teaching as is mostly the case in present-day Nigerian secondary schools (Sorunke, 1982). The Nigerian Integrated Science Project materials (Pupils Text Books I, II & III and Teachers' Guides Books I, II and III) also emphasize the use of activity-based methods of teaching like NISTEP. The main difference between NISP and NISTEP activity methods is that NISP emphasizes the use of materials, equipment or apparatus more often. In places where there are no materials, the teachers resort to the lecture method. In NISTEP mode of teaching, apart form the use of materials, equipment or apparatus, there is provision for other activities to supplement the use of materials that are not available. These are paper-and pencil or pen

activities, whereby if there are no materials for activities the teacher can use paper and pencil or pen for practical activities instead of simply resorting to lecture method of teaching. Details of NISTEP mode of teaching are included in Appendix A.

1.2.2 PRACTICAL ACTIVITIES IN SCIENCE

Practical activities have been viewed by many science educators as an important and integral aspect of effective teaching and learning of science subjects. Kempa (1986) defined practical activities as "those activities that form the integral part of any investigation process in science and through which the investigators obtain a first hand experience of some scientific phenomena or relationship. also Lock (1987) defined practical activities as "activities engaged in both by science teachers and students for meaningful teaching and learning of science. These involve observation, identifying problems, formulating hypothesis, design of experiments, control variables, analyzing data, making inferences and predictions"

Foxman (1988) defined practical activities in form of categorization.

a. "Practical' in the sense of "empirical" is concerned with knowledge gained through observation and experimentation.

b. "Practical" in the sense of "construction" using materials and apparatus to make things.

c. "Practical" in the sense of concrete modelling using apparatus and materials to illustrate relationship including for example scale models. There are practical situations as well as practical activities, such as those in everyday life. These activities relate to planning making decision,

organizing events at work or for leisure, for example, in shopping, planning a journey or organizing a party. Generally, practical activities in science are designed to help science students acquire basic scientific skills (e.g. observation, prediction, experimenting and reporting results). They also aim at the development of psychomotor and manipulative skills, as well as enhancing better understanding of the processes and products of science (Schwab, 1962; Head, 1971; Otuka, 1979)

Lock (1987) outlined a number of reasons for including practical activities in school science:

1. The inclusion of practical activities generates, in students, spontaneous interest in science.
2 Practical activities in science encourage inquiry-based learning. Students are given a set of problems and then directed to approach them in their own ways. They may be guided or unguided. In this process the students are allowed to make observations of phenomena, testing formulated hypotheses, making deductions, etc. these processes lead to the understanding of science concepts.
3 Meaningful learning is encouraged as students are able to talk to each other about their observations and inferences during the activities in science lessons.
4 Practical activities can help in fostering and developing positive attitudes in learners. At individual level it helps to develop self-confidence in pupils, and also provide satisfaction, especially when students successfully complete a task.

5 Practical activities help to refine the experience of learners in the process of learning and doing science.

Kirham et. al (1987) reinforced the views of Lock (1987) when he said that practical activities may also be seen as learning process in themselves. Futhermore, it is argued that practical activities in science lessons have a strong motivating influence and that they help students by reinforcing their understanding of scientific concepts. Beatty and Woolnough (1982) also stated other purposes of practical activities as follows;

a To develop the ability to communicate.
b To develop the ability to solve problems.
c To develop creativity in students.
d To help students do science rather than simply learn science.
e To prepare the students for practical examinations.

It is evident, from the above that practical activities serve important purposes in the teaching and learning of science.

There are wide ranges of practical activities which teachers provide for students during science lessons. These are classified into four main groups by Woolnough and Allsop (1985):

a Activities for motivating purpose.
b Activities for developing skills and techniques.
c Activities for developing problem-solving skills.
d Activities concerned with gaining better understanding of the theoretical aspects of the course.

Woolnough and Allsop (1985) further identified and classified three kinds of activities in school science, namely:

A **Exercises**; These are designed to develop scientific skills of observation, measurement, manipulation of equipment, etc. Example of activities that could be regarded as exercise include, for example:

i. Observing and describing, the effect of heating different substances.

ii. Observing, drawing and classifying plants and animals.

iii. Estimation of the size or volume of a classroom, etc.

B **Investigation**: These are designed to give students the opportunity to develop competence in using the scientific approach to problem solving. An investigation could be as brief as identifying the types of substances contained in the water from the school well or as broad as studying the kinds of distribution of animals in an aquatic environment. Examples of investigation are:

i. Analyses of caloric value of food substances.

ii. The rate of growth in plants.

iii. Causes of rusting, etc.

C **Experiments**: are aimed at helping students get a feel of the phenomena being studied.

These experiments are often short, quick, explorative experiments designed to enhance students' understanding of the scientific concepts, which is the major focus of this study. Examples of science practical activities in this category are :

i. Compressing the air in the syringe.

ii Studying chemical changes using colour changes.

iii Watching movements of simple organisms, etc.

The researcher made use of the exercise discussed above as practical activities in this study. The activities are helpful in developing scientific skills in students. The skills of observation, classification, experimenting, interpreting data and accurate recording of the results focused the forms of the practical activities in this study.

1.2.3 ACADEMIC ACIEVEMENT IN SCIENCE

Academic achievement is the measure of students' learning or acquisition of certain skills at the end of teaching and learning activities. Science educators have given various definitions of academic achievement. Marshall (1971) defined academic achievement as the "extent to which a person has achieved something acquired 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 pupils have learnt or attained after a learning period.

The definition of academic achievement as assessment used in this study is derived from those of Marshall (1971) and Iyang (1988) i.e the assessment of how much students have learnt, the extent to which a student has acquired certain information or mastered skills usually as a result of planned instruction or training.

Academic chievement is measured generally through test, and they are two types ; (i) Norm-referenced test,. (ii) Criterion – referenced tests (Bloom et al, (1971). In norm referenced tests students' test scores are given meaning in

relation to those of other students who are taking or have previously taken the test. While criterion- referenced tests involve tasks, which are defined by set of instructional objectives or set criterion.

They yield measurements that interpret students' performance in absolute terms such as percentage correct rather than in comparison with other students.

There are various kinds of instruments for measuring achievement in science. Inyang (1988) states that the purpose of measurements, instrument that could be used in making educational measurement include: Teacher – made tests, interview, opinionaire, questionnaire, standardized test, external, examination personality tests and interest inventory. Any human attribute such as learning achievement, emotion intensity, a skill, development of appreciation is measurable. In this study teacher made-tests as well as standardized tests were employed for measuring academic achievement as well as performance of students in practical activity.

1.2.4 TEACHING OF INTEGRATED SCIENCE IN NIGERIAN SCHOOLS

During the early 1960's, there was shift in the emphasis of science teaching from mere acquisition of knowledge to the teaching and learning of science through active involvement of pupils through practical-oriented activities. This shift came partly as a result of the launching into space of the sputnik by the defunct Union of soviet Socialist Republic (USSR) in 1957. This event challenged the United States of America (USA) to question the efficacy of science programmes that were operative in her various educational institutions (Olanrewaju, 1989). Various science curriculum reforms were consequently initiated in United States of America and United kingdoms. Such projects include the Physical Science Study Committee (PSSC), Chemical Bond Approach

(CBA), Science A Process Approach (SAPA), Elementary Science Study (ESS) among others. Although the movement started in the United State of America, it quickly spread to other nations including Nigeria, where Ahmadu Bello University's Primary Education Improvement Project (PEIP) and other programmes were introduced. In Britain, the Nuffield Science Project was also introduced from 1969 to 1970 a number of integrated science programmes including the Scottish Integrated Science Course and School Council Integrated Science Projects were also introduced in Britain

In Nigeria, the effort that finally resulted into the development of the Nigerian Integrated Science Project (NISP) started as a request from the West African Examination Council (WAEC) to the Science Teachers' Association of Nigeria (STAN) in 1968. The Examination Council requested STAN to make recommendations to enable her to review the West African School Certificate (WASC) science syllabus. In response to the request, the National Executive Committee of Science Teachers Association of Nigeria (STAN) constituted three curriculum Development Committees, one each in biology, chemistry and physics in May 1968. Later that year a forth committee, the mathematics committee then crystallized its thought to produce the document which was published in January 1970, under the caption "Curriculum Development News letter No. 1 which contained statement of philosophy, methodology, content and evaluation of integrated science. Firmly rooted in the ideas expressed in this document is the fundamental issue of integration in the sciences, which is aimed essentially at producing a course that:

i. is relevant to students' need and experience
ii. stresses fundamental unity of science.

iii. lays adequate foundations for subsequent specialist study and

iv. adds a cultural dimension to science education (STAN newsletter No. 1, 1970).

After the implementation of the Nigerian Integrated Science Project (NISP) curriculum for about a decade, it became necessary to revise it in line with the new National Policy On Education (FME, 1981 revised). Consequently integrated science taught in the secondary schools changed from being a two-year to a three-year course during the first three years of secondary education in line with the 6-3-3-4 educational system.

The objectives of the core-curriculum for integrated science introduce as a course for junior secondary schools (STAN newsletter No.1, 1970), was expected to help pupils to:

a. be actively involved in the learning process;

b. develop the ability and motivation to work and think in independent fashion;

c. recall information and experience;

d. device scheme for solving problems;

e. use and classify giving information;

f. apply previous knowledge to new situations;

g. interpret information showing evidence of judgment and assessment;

h. communicate selectively and effectively and

i. relate their experience in each subject area to other subject areas and life in his society.

Furthermore, these modes of behaviours were to involve the pupils in the acquisition of series of skills such as:

I. Observing carefully and thoroughly;

II Reporting completely and accurately;

III Organizing information acquired by the processes;

IV Generalizing on the basis of acquired information;

V Predicting as a result of these generalizations;

VI Designing experiments (including controls where appropriate; to check these predictions)

VII Using models to explain phenomena where appropriate and

VIII Continuing the process of inquiry where new data do not conform to prediction

After using the Nigeria Integrated Science Curriculum for a decade between (1972-1982) (1972 when the first STAN integrated science text "Nigeria Integrated Science Project (NISP)" was introduced and 1982, when the revised edition emerged in accordance with the integrated science core curriculum) a number of studies had been carried out to asses the success or otherwise of the implementation of integrated science in schools in the country. These studies include those by Mani (1981), Jegede (1981) and 1982), Eshiet and Iyang (1985), and Inyang (1988).

The studies dealt with teachers' qualification, students' performance, test item construction and effect of practical activities on students' academic achievement. The results revealed that there are inadequate qualified teachers to handle the subject. Teacher-made tests were poorly designed and were mostly at the lower levels of Blooms' cognitive domain. Also practical works were not adequately conducted and were mainly for demonstration purposes. This resulted in low academic achievement in integrated science among other effects.

1.3 STATEMENT OF THE PROBLEM:

Practical activities in science are designed to help students verify or practicalise claims that are contained in the materials taught in science lessons. Practical activities also enhance better understanding of principles, and concepts underlying scientific theories. Practical activities in schools are carried out so as to enhance effective teaching and learning science subjects. Lack of practical activities and constant use of the lecture method are some of the factors contributing to poor academic achievement of students in science as observed by Eze (1976), Jegede (1981), Mani (1981), and Kempa (1986), Studies on the relationship between the performance of students in practical activities and their academic achievement were relatively few and essentially limited to comparison of students' performances in practical work and academic achievement under a given experimental setting without much effort to determine their relationships. Therefore, studies that deal with the relationship between students' performance in practical activities and students' academic achievement at junior secondary school level is required. Lack of awareness of the type of relationship existing between students' performance in practical activities and their academic achievement in science could be another factor responsible for poor academic achievement of secondary school students more especially as it pertained to the NISTEP which is a relatively a new mode of instruction in Nigeria.

Specifically, the study is aimed at finding answers to the following relevant questions:

1 Is there any significant relationship between junior secondary school students' performance in practical activities and their academic achievement in integrated science when exposed to NISTEP mode of teaching?

2 Is there any significant relationship between the performance of male students in practical activities and their academic achievement in integrated science using NISTEP mode of teaching at junior secondary school level?

3 Does the performance of female students in practical activities relate significantly to their academic achievement in integrated science using NISTEP mode of teaching at junior secondary school level?

4 Does NISTEP mode of teaching enhance students' academic achievement in integrated science at junior secondary school level compared to the traditional lecture method?

5 Is there any significant difference in the performance of male and female junior secondary school students in practical activities when exposed to NISTEP mode of teaching?

6 Do male and female students perform equally well in practical activities when exposed to NISTEP curriculum in integrated science at junior secondary school level?

1.4 RESEARCH HYPOTHESES

The following null hypotheses are formulated in order to answer the questions above.

1 There is a no significant relationship between students' performance in practical activities and their academic achievement in integrated science at the junior secondary school level using NISTEP mode of teaching.

2 There is no significant relationship between the performance of male students in practical activities and their academic achievement at the junior secondary school level using NISTEP mode of teaching.

3 There is no significant relationship between female student's performance in practical activities and their academic achievement in integrated science using NISTEP mode of teaching at junior secondary school level.

4 There is no significant difference in the mean scores of students, taught using the NISTEP mode of teaching in their academic achievement and those taught using the traditional lecture method in integrated science at junior secondary school level.

5 There is no significant difference in the mean scores of male and female students' academic achievement in integrated science when exposed to NISTEP mode of teaching at Junior secondary school level.

6 There is no significant difference in the mean scores of male and female junior secondary school students in practical activity when exposed to NISTEP mode of teaching in integrated science.

1.5 SIGNIFICANCE OF THE STUDY

The finding from this study will hopefully contribute to uplifting the standard of science education in a number of ways. First, it is expected that the findings of this study will encourage science teachers in secondary schools to improve in the practical activities conducted by utilizing child-centred, activity based methods, such as NISTEP.

Education planners and curriculum designers will hopefully benefit from the findings of this study through the evaluation of teaching and learning of integrated science in secondary schools, in order to improve junior secondary school students' performance in integrated science. Since there is need for improvements in the teaching and learning of integrated science as observed by

Mani (1981) and Jegede (1982). This would be done through inco-operating NISTEP mode of teaching in the secondary school curriculum. The finding also suggests the use of NISTEP mode of teaching in dealing with gender-related issues in the teaching of integrated science in schools. To some extent, in a situation where practical materials are insufficient or lacking as well as in a situation where practical activity is difficult to be organized in some topics such as, control of diseases and man in space, NISTEP paper and pencil activity could be employed in the secondary schools. This will help the Federal Ministry of Education and State Ministries of Education in solving such related problems and at the same time enhancing students' performance.

1.6 BASIC ASSUMPTIONS

In carrying out the study the following assumptions were made:

1 Students in the study sample have had adequate introduction to integrated science course content as stipulated in Nigeria Integrated Science Project (NISP 1991) syllabus.

2 Practical activities are interwoven into the integrated science as spelt out in the Nigeria Integrated Science Project (NISP, 1991) core-curriculum.

3 The available materials, (such as text books, and practical materials as spelt out in NISP syllabus (1991) have been utilized in teaching and learning of integrated science.

4 In most of the secondary schools visited there were insufficient laboratory facilities for the integrated science teaching.

1.7 DELIMITATION OF THE STUDY

The topics and tests in this study were based on the content and objectives of the Nigeria Integrated Science Project (NISP, 1991) Teachers' Guide Book III and Pupils Text, Book III were used since the study focused on junior secondary III students as the study sample. Multiple-choice type test items were employed for assessing students' academic achievement while short answer test items were used for assessing students' performance in practical activities. Two schools were selected out of nine from Sabon Gari Local Government of Kaduna State. Because the schools are co-educational and are suitable for the design of the study since gender is among the variables to be tested in this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

An attempt is made in this chapter to examine the literature related to this study worldwide in general and in Nigeria in particular. Research reports, writings and publications have been critically considered and those that have relevance for this study have been out-lined and organised into the following headings:

(a) Curriculum innovations in Science Education that Emphasis the Importance of Practical Activities.

(b) Practical Activities in Science Education

(c) Psychological Considerations in Practical Activities in Science Education

(d) Philosophical Considerations in Practical Activities in Science Education

(e) Need for Practical Activities in Integrated Science Teaching.

(f) Relationship Between Gender and Achievement in Science.

(g) Relationship Between Practical Activities and Academic Achievement in Science.

(h) Related Literature

(i) Implication of Literature Review for the Present Study

(j) Summary.

2.2 CURRICULUM INNOVATION IN SCIENCE THAT EMPHASIS THE IMPORTANCE OF PRACTICAL ACTIVITIES.

Nigeria Integrated science project; among others, is one of the innovation in science education that emphasized the importance of practical activities. During the 1960's the attention of scientist and science educationist were focused on the problem of improving science instruction in the secondary schools. Most of the available curriculum materials utilized were based on "science approach" students were permitted to actively participated in science discovering resulting from efforts they had designed and directed.

Early in the 1950's the members of National Science Foundation in USA frequently discussed expensive curriculum revision. Owing to financial difficulties, major curriculum efforts did not appear feasible. In 1957, the Russian space achievement jarred the United States of America. In 1958, the National Science Foundation in USA, and other groups were already deeply involves in funding science curriculum projects. Some of this includes the following: Physical Science Study Committee (PSSC), Chemical Bond Approach (CBA) and Chemical Education Study Material (CESM) among others. These include Biological Science Curriculum Study (BSCS), Harvard Physical Project (HPP), Science A Process Approach (SAPA) and Elementary Science Study (ESS) among others. The projects were initiated in United States. The Nuffield and the school science were develop in the Great Britian. These projects succeeded in developing much out-standing science materials. These innovation projects started and the increase effort of colleges and universities in revising, as well

improving their output helped in improving science instruction in both primary and secondary schools. Provision of adequate materials and intensive campaigns helped a lot in the improvement of science instruction at the level of education stated above.

A highly significance feature of the above projects at elementary and secondary school is the large-scale involvement of scientists in the development of the project.

In all these curriculum innovations, the project evolved provided some vital change in pedagogy from traditional content and factual knowledge approach to that of students' active involvement in learning science by doing. In Nigeria, science projects that emphasized practical; activities are; the Nigerian Secondary School Science Project (NSSP) Developed by Comparative Education Study and Adaptation Center (CESAC). Also Nigeria Integrated Science Project (NISP) developed by the Science Teachers Association of Nigeria (STAN). Recently, the Nigeria Integrated Science Teacher Education Project (NISTEP) was developed by the Institute of Education Ahmadu Bello University, Zaria. This was in conjunction with Kings College London and intended for Nigeria Colleges of Education.

There are various methods of teaching that enhance students' active participation in learning science. The inquiry method encourages students' involvement in formulating a problem and following logical sequence in finding its solution. (Schwab, (1962) and Kuhn, (1970), advocated this approach of science instructions. Namely;

(a) Stable and Fluid enquiry and;

(b) Normal ad revolutionary science.

Stable enquiry of Schwab (1962) and normal science of Kuhn (1970) refers to the discovery of knowledge, which is designed to fill a particular gap in a growing body of knowledge. Schwab linked it to constructing an edifice without questioning its plan. While fluid enquiry of Schwab (1962) and revolutionary science of Kuhn (1970) referred to a mode of investigation which depends on conceptual innovations proceedings through uncertainty or failure. This investigation at the end arrives at knowledge, which is contingent, dubitable and hard to come by.

Brunner (1961), proposed the use of discovery method in teaching and learning of scientific concepts and importance to practical activities in science. He stressed the importance of learning by discovery and effective Stimulation of what scientist do through problem solving. Brunner further observed that a discovery activity is a lesson designed in such a way to enable students generates idea from their experiences. This generalization could be achieved through the use of mental processes like observing, measuring, classifying, inferring, and hypothesizing to mention but few. Discovery learning when encouraged in science classes aids problem solving. It also promotes the development of creativity in students, which is primary objective of science teaching. Discovery can be effectively realized when practical activities are

designed towards helping students to discover concept and principles for themselves.

Also, the work of Piaget (1977) in developmental psychology has become an importance guide in the selection and arrangement of science practical activities for student at various stages of development processes. The study of science at primary and junior secondary school level should emphasis the art of observation through the use of the basic senses. Greater emphasis should also be placed on doing rather than telling. This will provide opportunity for students to discover concepts for themselves, having making learning meaningful and enhance better students' performance in science. Activities for primary and junior secondary schools required children to explore, observe and question their environment, Piaget (1964). The ability of pupils to explore, observe and question their environment will lay a good foundation for further studies in science education. Various studies on the other hand supported the ideas spelt out in curriculum innovation as reported by Jegede (1981), Mani (1981), Sorunke (1982), Brunner (1982), and Alabi (1980), to mention but few. They observed that the ideas stipulated in the innovated curriculum makes student to be active learner, they concluded that students enjoy measuring, designing, experiments, hypothesizing and making inferences.

From the forgoing, it is apparent that the innovations in science instructions that emphasis the importance of practical activities have received much attention more especially during the last few decades. Also from various literature cited, it must be pointed out that practical activities should be effectively

conducted in science lessons. Materials are required in order to give meaningful learning to students in the teaching of science. This study monitored the aspect of providing an alternative in a situation where there are no enough materials for practical activities in science lesson. This was done through investigating the relationship between performance of students in practical activities and their academic achievement in integrated science at secondary school level using NISTEP mode of teaching. This allows provision to be made through given appropriate advice for improvement where necessary.

2.3 PRACTICAL ACTIVITIES IN SCIENCE

The importance of practical activities in science education cannot be over-emphasised Woolnough and Allsop (1985), mentioned that science teachers often appears to work on the assumption that scientific knowledge is objective and needs only good teaching to impart the knowledge into the learners' minds. The teacher is at that centre and directs the student who fulfil " a rat model "in a behaviorist exercise, which Woolnough and Allsop believed is unhelpful. Students are continuously inquiring testing, speculating and building their own idiosyncratic constructs of knowledge. It is only by personalising such knowledge that it becomes valid, meaningful and useful. In science, students need to actively construct their own personal awareness and meaning of natural phenomena. This could be achieved through their involvement in practical activities. Osborne and Wittrock and Woolnough and Allsop (1985) stated the case clearly when speaking of the generative model. Osorbone and Wittrock

opined that the brain is not a passive consumer of information and inferences. To learn with understanding a learner must actively construct meaning of events surrounding him/her. The successful learning of scientific ideas is as result of restricting of the way learners think about the world. Construction of concrete meaning in science could be enhanced if practical activities are effectively carried in schools.

Much science teaching is based on the assumption that a scientist work by process of learning, and formally articulating the basic concepts and principles to solve problems. Science teaching is also design to give students understanding of high level of the concept and application of it in solving problems. Scientist believes that science as a problem-solving activity promotes the understanding of its fundamental concepts. This could not always be achieved through theoretical lessons alone. Given practical activity consideration aids effective problem-solving activity in science, Kempa (1979).

In another dimension Woolnough and Allsop (1985) highlighted the danger of combining practical activities and theoretical aspect of the lesson in science. They stated that the aims of each are not distinguished. In this way, practical activities have become distorted and theoretical understanding not satisfactorily achieved. However, Woolnough and Allsop opinned that initially theory aspect of science lesson and practical aspects should be considered separately from each other. In doing this, self-sufficient rationale and modus operandi for each aspect would be achieved. Also there will be an important interaction between the experience gained by the student in doing practical activities and the theoretical

understanding achieved by underlying and the areas of interaction that this study has examine in order to determine how performance in practical activities relates to academic achievement in integrated science using NISTEP mode of teaching. Driver (1983) explained that children have been active as scientist through observing, testing, hypothesizing and evaluation. They come to the science class with minds with a lot of experience and insights, which may if ignored prove very difficult to alter. Driver also stated that the assertion that students come to science school with empty mind is false and educationally disastrous. Therefore, there is need to incoporate the previous knowledge of the learner in school science laboratory. This will make practical activities meaningful to him.

From the foregoings, it can be seen that students come to science lesson with various scientific experiences. Such in sight are often partially ill-formed but personally meaningful. In support of Driver's view Osborne and Wittrock stated that teaching needs to fully incoporate pupils viewpoints in science teaching. Where appropriate, attempt should be made to modify or build on these views, but certainly children ideas should not be ignored.

The first step in using ideas in the teaching of science is to help them articulate and develop their views through discussions. Appropriate insight relevant to students' thinking could be channelled into the teaching and learning of science. This could be achieved through their active involvement in practical activities as in the case of the present study.

Roberts (1975) remarked that practical nature of science subjects is commonly regarded as an important source of motivation for pupils. This

motivation can lead to improvement of students' academic achievement. Several science educators, however recognised the value of practical activities in science education (Schwab, 1962, Kerr, 1963, Green, 1965, Eglen, and Kempa, 1974, Brian, 1975, Otuka, 1979, Akale and Aminu, 1981, Jegede, 1982). Other science educators like Ango and Silas (1986) believed that practical activities in science subject are important. They also remarked that the understanding of principles and application of scientific concept enhance students' academic achievement.

While Saadeh (1973), opined that practical activities are designed to promotes sense of inquiry and discovery in student among others in science lesson. Saadeh stated that this practical activities have not produce any impressive result on students' performance in secondary schools. Also Hemstead (1973) view the relationship between practical activities in science and students' academic achievement as having a little value. He reported that practical activities in science are described as being too expensive and are too dangerous for pupils to handle.

Bichi (1988), carried out study on the designed of an inventory of skills in senior secondary school biology practical. He found that there was high positive correlation between students' scores in practical activities and their scores in theory test. Bichis study thought in biology gave an insight on the relationship between students' performance in practical activities and their academic achievement in theory. It is also lays foundations for which this present study focuses although in integrated science and using NISTEP mode of teaching.

Urebru (1990), observed that science is a discipline that provides training for the hand, eyes, ears, as well as the brain. How can a teacher train his pupil properly if he refuse to practice what he teaches? He should be constantly looking for new and better ways of teaching using simpler and more accurate apparatus, interesting and instructive experiments. This implies that he must try new practical ideas to improve the teaching and learning process. In the present study, NISTEP Mode of teaching have been utilized to see how effective it will be on both practical activities performance and academic Achievement of students at junior secondary school.

Yager as reported in (Bajah 1995) warns that some activities called practical by teachers, textbooks, authors and curriculum developers are not practical (that is to say useful and meaningful for the students who experience them). To be practical for students the work must be demonstrable useful in their lives. The work is practical because it focuses on students' own question, explanation, their test of validity for such explanation and their own actions following problem resolutions. With this argument it is important to investigate the relationship between students' performance in practical activities and their academic Achievement in integrated science using NISTEP mode of teaching which is full of activities and relevant to pupils' experiences.

This study was aimed of determining the relationship between students' performance in practical activities and their academic achievement using NISTEP mode of teaching to see whether the result could be the same or different from other reviewed stated studies.

2.4 PSYCHOLOGICAL CONSIDERATION IN PRACTICAL ACTIVITIES IN SCIENCE EDUCATION

Science cannot be properly develop without the use of effective practical activities understanding of scientific concept and underlying principles are fundamental to teaching theories, (Lock, 1960, and Piaget, 1977). Piaget (1964) also observed that intelligent is a continuous process of " adaptation and organization" As the child interact with the physical and social environment. One of such interaction could be achieved through practical activities in science. Practical activities in science allow the child the child to be able to manipulate, observe, and experiment with various types of apparatus. This will enhance the understanding of concepts taught. Piaget also pointed out that, movement from one cognitive stage of development to the other can be achieved when children are provided with rich experiences. The experiences acquires help to develop a mental framework to be used in situation that warrant practical encounter with natural world. This statement has highlighted the importance of psychological principles in the acquisition of concepts in science. Molitor (1971) and Tannabaun (1971) believed that increase in skill performance must be acquired through encounter with experiences with practical skills in science. Practical skill experiences could be achieved through practical activities in science. Molitor and Tannabaun recommended that practical activities in science should be conducted so as to encourage students acquire skills relevant to their day-to-day activities. The above observations indicate the importance of psychological attribute to acquiring of practical skills, such as observation, hypothesizing, experimenting, data collection etc. in practical activities lessons in science. The

experience and its application could be used in learning situation. Gagne (1965) viewed practical activities in science as a foundation for scientific enquiry needed for learning concept of science. During practical activities students are allowed o handle, observe, and experiment using different types of materials. These Are used for investigating certain concepts and principles by themselves making learning meaningful to the students. From psychological point of view the students are learning by doing. The statement indicates that practical activity is an important aspect of psychological development of individual student in teaching and learning of scientific concepts and cognitive development.

Science is a dynamic disciplines, hence requires the teaching of practical activities needed for acquisition of scientific skills. Without effective utilization of practical activities, scientific advancement in science will not be achieved, Hurd (1967). Hurd et al (1967) , also pointed out that science as a field of study is characterised by a moving frontier and an ever increasing knowledge. They further said that young people need to acquire those skills and abilities, which will enable them assume responsibilities for expansion of their own leaning. The students become self-reliant and independent they can easily apply the learning tools, processes and practical skills in enquiry and solving new problems. The psychological implications of the above statement is that when students acquire practical skills it will make them competent in the use of their cognitive structure. This will enhance their acquisition of new knowledge in science. It will also provide the students with experience that they can apply through the practical skills acquired to their social and cognitive problems.

Also the work of Piaget, has become an important guide in use of practical activities in science. Piaget, postulates that about the Age of eleven or twelve, during this period, the child's mental process is thinking more on what he can observe and handle, such as objects. The concepts of quantity, time, speed, conservation and reversibility have not fully developed. At this stage also logical processes such as observing, describing, classifying and measuring objects take place, Piaget suggested that in order to encourage and promote logical process mentioned above in teaching and learning at child's concrete operational stage, a lot of practical activities is required. This should be done through the process of observation using their senses of sight, smell, hearing, touching and testing as in the case of the present study. Piaget further mentioned that greater emphasis should be placed on doing rather than telling. Children need to explore and observe their environment. Fro this psychological point of view, it has been emphasized that children need to be involved actively in practical activities in science. Their active involvement will help in their cognitive development.

Another psychological consideration for conducting practical activities in science according to Beatty and Woolnough (1982) is that the activities arouse and maintain students' interest towards learning situation. Logical reasoning is promoted and making learning meaningful practical activities in science is also an important motivation for meaningful teaching and learning of science.

From the foregoing, psychological consideration for the use of practical activities in science has been described. Practical activities as a pre-requisite for effective teaching and learning of science to be encouraged. Science teaching

cannot be effective without practical Activities. Like wise efficient development of individual cognitive structure, psychomotor and affective development c can be achieved through the use of practical activities.

2.5 PHILOSOPHICAL CONSIDERATION IN PRACTICAL ACTIVITIES IN SCIENCE EDUCATION

The philosophical premise upon which practical activity in science is based, is that knowledge develops from sensory experience. Philosophical view term inductivism claims that individuals attain meaningful knowledge only from experience with physical environment. For example, Hume (1974) proposed that all perceptions of the mind could be divided into two classes called impression and ideas. For Hume, impression are the direct sensation received by the senses, and the basis of all knowledge. Simple ideas are the images of these sensations that remain after an impression has occurred. This view holds that concepts are formed from sensory impression or experiences. Hume philosophical view therefore emphasizes the use of the senses for the encouragement of formation of meaningful concepts, which can be enhance through practical activities in science teaching and learning. Dewey as reported in Thakur (1977), observed that an inert mind waits for experience. Curiosity ultimately becomes intellectual when it takes the form of purposeful and systematic interest in question or problem set by the observation of things. The accumulation of experiences, thus gained challenges one to inquire still further. Through provision of practical activities in science, the above stated experience can be achieved in science, among others are acquisition of skills of observation,

problem solving, enquiry and utilization of the experiences' results to the day-to-day experiences. However, Dewey also remarked that scientific inductive demands a higher degree of exactness and thoroughness. This elaboration brings specialization and marking-off of various problems from one another, and a corresponding classification of the materials of experience associated with each type of problem. This inductive and deductive reasoning can interact through the practical activities in the teaching and learning of science. Dewey in Thakur (1977), mentioned that "good educational aim must be founded upon the intrinsic activities and should be given according to the individual to be educated"

Dewey emphasized that, practical activities should be more concerned with its nature rather than mere abstracts disconnected from means. Also Crompton as reported in Thakur (1977) observed that science is not a technique or a body knowledge though it uses both. It is rather an attitude of inquiring of observation and reasoning with respect to the world. It can be developed not be memorization or judggling formulae' to get an answer, but only in actual practicalizing of scientific observations and reasoning. Crompton also maintain that the development of science could be retarded without practical activities. Science progresses through practicing and not by mere telling (Conant 1951).

Another important feature of practical activities in science is that it erases the artificial distinction between the mind (cognitive) and the hand (psychomotor) it is dangerous to treat them as if they are separates entities, Dewey as reported by Thakur (1977). Schwab (1962) described practical activities as participation in a series of experimental, observational, and demonstrable activities. These practical activities provide students opportunity to develop and understand scientific concepts both practically and theoretically.

Harrison (1965) argued that, science is regarded as major part of modern culture, an essential tool for helping tomorrow's citizen to understand the world in which he lives. Such knowledge has some practical values, which are discovered in practical activity oriented lessons. The pupil is asked to discover general principles for himself and he is led right-up to the present frontiers of knowledge of science. This discovery can be achieved through practical activities instead of concentrating solely on discoveries made before the turn of the century.

From the foregoing, practical activities have a significant role in the teaching and learning of science and its processes, practical activity needs to be given adequate consideration for the upliftment of frontier of knowledge of science.

2.6 NEED FOR PRACTICAL ACTIVITY IN INTEGRATED SCIENCE TEACHING

Integrated science method of teaching is activity-based. It requires the use practical activity in its teaching and learning procedures. With reference to integrated science aims and objectives as started in chapter 1 section 1.2.4. of this study by Science Teachers Association of Nigeria (STAN. 1970) cannot be achieved without the use of practical activities therefore there is need for the use of practical activities in integrated science teaching and learning, if the stated objectives are to be achieved. There are various scientific skills (such as, observation, prediction, experimentation etc), to be acquired in integrated science teaching. These skills acquisition cannot be realized without the use of practical activities in teaching and learning of integrated science. The need for practical activities in integrated science is also emphasized by Jegede (1981), Mani (1981), and Asun (1988) among others.

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Asun (1988) observed that integrated science must be a science course, which in teaching each of the ideas of science, such as energy, conservation of matter, equilibrium etc., frees itself of the restriction imposed by the arbitrary subject boundaries of separate science. Asun opined that, this idea of integration should be reflected in the theory as well in practical activities. The need for integration of practical activities in teaching and learning of integrated science has also been supported by Asun.

Akale (1988) noticed that "science is both a process as well as a body of knowledge, both must feature in teaching of integrated science. To achieve these practical activities need to be incorporated with theory in teaching and learning of integrated science.

Various studies have been carried out on the implementation of integrated science programmes, Jegede (1981) in his evaluation of effectiveness of Nigerian Integrated Science Project (NISP) programmes found that:

a The teachers are favourably disposed towards the project.

b The cognitive objectives achieved were below expectation

c A significantly negative relationship exists between the students' attitude to and achievement in the project.

According to Jegede the above finding, were as a result of:

i. Lack of appropriate materials and training for teaching the subject;

ii. The poor science background of the students at the primary school level;

iii. The introduction of the NISP materials into schools without trials and retrials aspects of the project:

iv. The practical activity aspects were neglected, due to lack of materials to use. This present study therefore, has provided an alternative mode of

teaching in a situation were material is lacking during teaching and learning of integrated science.

v In another study, Jegede (1982), also found that the distribution of questions in integrated science are in the lower cognitive domain of Bloom's taxonomy of educational objectives from Jegede's observation it is quite obvious that practical activities in integrated science are neglected in both teaching and test items constructions. In this present study therefore attempt was made to inco-operate practical activities in the test items to be used for this study. To see whether there will be an improvement on Jegede's finding or not.

Mani (1981) carried out studies on the evaluation of integrated science programme in different parts of this country. He found that the teachers employed in the teaching of integrated science were not specialist in the field. The handling of the practical as well as theoretical aspect of the subject was not encouraging. Eshiet and Inyang (1985) also pointed out that, both teachers' qualification and students' performance do no meet the requirement of the curriculum objective in integrated science. Since both authors agreed that teacher's qualification and students' performance are quite discouraging in integrated science, there is need to revisit the practical activities conducted in integrated lessons as it relates to student's academic achievement. This is necessary in promoting quality teaching for the improvement of students' performance in science education.

Mani (1982), also used teacher-made class examination as one of the six variables chosen to be observed as one of the specific classroom behaviour implied in NISP curriculum objectives. The items examined showed that the examination consisted of mainly items for testing pupils' recall, comprehension

and application of information while items of higher process skills were totally absent.

From the literature reviewed so far it seems that little emphasis has been given to practical activities in integrated science. This may be due to lack of material, equipment and apparatus for practical lesson in integrated science. Also negative attitude of both teachers and students may be another contributing factor. Lack of awareness of existing relationship if any, between practical activities and performance in academic achievement by both teachers and students might be another contributing factor to students' poor academic achievement in the subject, which is the focus of this study more especially by the use of NISTEP mode of teaching.

Finally, looking at the National Policy on Education (FME, 1981) and integrated science core-curriculum as stipulated in NISP (1991) they both agreed that the essence of an integrated science course is to teach the child how scientist work. The teaching and learning of integrated science might be improper without the use of practical activities. This can result in poor students' performance in the subject.

2.7 RELATIONSHIP BETWEEN GENDER AND ACHIEVEMENT IN SCIENCE

The achievement of students in many learning situations depend on the school location, socio-economic background, teacher qualification learners' attitude, the mode of practical activities, and sex of the learner.

Many studies have pointed to the fact that male students are academically superior to their female counterparts (Ogunyemi, 1973, Comber and Keeve, 1973, Ibeme, 1975 Jegede, 1981; and Inyang, 1988). While studies carried out

elsewhere, (Terman and Tyler, 1954; Dale, 1962; Wisenthal, 1965; Maccoby, 1966; and Mari, 1994) revealed that females are academically superior in mathematics and sciences. Also studies carried out by Nwachukwu (1982), Daramola (1983), and Inomiesa (1985) revealed no gender difference in both academic achievement and performance in practical activities in the secondary schools. One of the aims of this study is an attempt to shed more light as regards the above controversy, especially when using NISTEP mode of instruction.

2.8 RELATIONSHIP BETWEEN PRACTICAL ACTIVITY AND ACADEMIC ACHIEVEMENT IN SCIENCE

Practical activities have traditionally played important roles in science education programme. It is intricately woven into the teaching of science instruction in schools. A number of observations about the relationship between practically activity performances and academic achievement in science, include those of Hemstead (1973), Saadeh (1973), Driver (1983) Muazu (1983), Kempa (1986), Bichi (1988), Lock (1987), Allsop (1985) and Woolnough (1985) among others. The studies of Hemstead (1973) Saadeh (1973), Driver (1983) and Woolnough (1985) revealed that there is no relationship existing between practical activity performance and academic achievement of students in science. They argued that, practical activities are costly, time consuming and dangerous to pupils to handle. They conclude that many of the stated aims for conducting practical activities are not achieved in the kind of practical activities often seen in schools.

In another development, Muazu (1993), Kempa (1986), Lock (1987), and Bichi (1988) found that there is "strong" positive relationship between students' performance in practical activities and their academic achievement in science.

These studies were relatively few and conducted at senior secondary level of education. Therefore this type of study is also require at junior secondary level of education using NISTEP mode teaching to see if the result could be the same or different. Therefore this study was done to determine the relationship between students performance in practical activities and their academic achievement in integrated science at secondary school level using NISTEP mode of teaching.

2.9 RELATED LITERATURE

A number of studies carried out on practical activities and academic achievement include the following, Green (1985), found that practical activities enhance academic achievement of students in science. He recommended that, the number of hours allocated for practical activities, lesson in biology should be twice of the number of hours allocated to theory lessons, this will enhance academic achievement of students in the subject.

Fowler and Brosius (1968) carried out a study on the value (such as skill, and attitude etc) gained in practical activites. They dissected four types of animal, earthworm, crayfish, frog, and pearch. This was done along with viewing the film of similar dissection, they found out that the two methods (dissection and film viewing) were equally effective in improving the students' understanding of the method and improvement in skill manipulation of the instrument. Fowler and Brosius studies were based on the relationship between two types of methods of dissection and students' academic achievement. The finding revealed that any of the methods used enhances students' academic achievement. In the present study, therefore NISTEP mode of teaching is used to determine its effect on students' performance in practical activity as well academic achievement.

Buckley (1970) carried out a study on the type of approach of assessing practical activities in science. These are product/out-come based assessment and process- based assessment. He got a correlation coefficient of 0.25 and 0.35 respectively in his studies. He found that performance in practical activities improves students' academic achievement. Buckley's study dealt with assessment of practical activities. Improper assessment of students' practical activities performance could be another factor resulting to poor academic achievement of students in the subject. Therefore in this study, the assessment of students' performance in both practical activities and academic achievement have been investigated and correlated to see what the overcome will be.

Hemstead (1973) found that the relationship between performance in practical activities and academic achievement is low. He mentioned that practical activities has little value to learning. He described practical activities in science as being dangerous and too expensive for students to handle in-term of space-time and equipment. He got correlation coefficient of 0.15 from his study. In addition he remarked that there is improper assessment of students' practical activities in science lessons.

Kempa (1979) replicated the study carried out by Buckley, and obtained the same low correlation value of 0.25 and 0.35 respectively between the product-based assessment and process-based assessment of practical activities respectively. He further stated that, performance of students, in practical activities do not rely on product alone or process itself, the two have to be noted. The aim of this present study is to investigate not only the performance in

practical but also students' academic achievement using NISTEP mode of teaching and to investigate their relationship if any.

Abraham (1980), correlated the performance of students in theoretical and practical lesson in physics among I.J.M.B. candidates of Ahmadu Bello University Zaria. He found that there is a weak correlation of 0.23 which shows that students could not relate what they learn during practical lesson to theoretical concepts and principle which is one of the main objectives of science teaching.

Ilioje (1981) found that the performance of students in WAEC practical examination paper often determined their success in academic achievement in secondary school science lesson. Therefore it is important to investigate this type of situation if NISTEP mode of teaching is used as in the case of the present study at junior secondary school level integrated science lesson to see whether the result could be the same or different.

Bichi (1988) carried out a study on the design of an inventory of skills in secondary school practical biology. He found that there is high positive correlation between the two sets of score, indicating that performance in practical biology was not necessarily determined by achievement in biology. In this study the students performance in practical activity and their academic achievement in integrated science using NISTEP mode of teaching will be determined and correlated to see what the findings will be.

Mari (1995) in his study on the understanding of science processes and its relationship to achievement in integrated science among secondary schools used

Test of Practical Skills (TOP) and Inventory Of Science Processes (TOSP) to collected data from 330 subjects.

From the results, the following conclusions were made

i. The subjects tested exhibited low understanding of science processes;

ii The level of understanding of science exhibited by the students was found to be related to the number of years of exposure to the NISP.

iii The female subjects exposed to NISP showed a better understanding of science processes than their male counterpart.

iv A high positive correlation between students' understanding of science processes and achievement in integrated science was obtained.

Mari attributed the subjects' low understanding of science processes to teachers' inability to organised and direct process based activities. In this present study a similar correlation investigation will be conducted between performance in practical activities and academic achievement among secondary school students using NISTEP mode of teaching to see whether the result will be the same or different.

Watson and Prieto (1995) carried out study on the effect of practical work on students' understanding of combustion. The study contains two components; a description of the teaching and learning to which the students had been exposed, and an investigation on England and Spanish students' explanation of combustion. The information were collected by the use of questionnaires sent to science teachers in two countries. This was followed up by interviews with the

science teachers of the students selected for the study, to give a more detailed description of the kinds of activities experienced by the students. Total number of 299 students were used ages 14 and 15,150 students from Spain and 149 from England. The result of this study revealed that, the approach in England was much more practical and give the students experience and it enhances their understanding of combustion.

From the observation on the literature cited there is need to further carry out study on the relationship between practical activity and academic achievement in science using another form of instruction such as NISTEP.

2.10 IMPLICATION OF LITERATURE REVIEWED FOR THE PRESENT STUDY

In the literature many articles suggested that students need to be involved in practical activities in order to comprehend and apply science concepts principles etc. This implies that effective practical activities in science enhance academic achievement too. The possibility of the existence of relationship between performance in practical activities and students' academic achievement was examined in this study

The literature revealed that students exposed to practical activities achieved higher academically than those not so exposed. The implication of this is that, if students are to have proper understanding of practical activities they should be exposed to science programmes that emphasis activity based method teaching. Integrated science is one of such programmes. From literature there is

little or no evidence of studies into relationship between students' performance in practical activities and their academic achievement especially using NISTEP mode of teaching at secondary level of education. This study therefore was conceived to fill perceived gap.

2.11 SUMMARY

The literature reviewed has considered a number of issues. These include curriculum innovation in science education that emphasized the important of practical in science. The review revealed some innovations (such as new method of teaching, the use of practical activities among others) in science curriculum that emphasis the use of practical activities. Various curriculums reviewed also provided some important contributions to this study.

Secondly, the literature reviewed considered practical activities in science. This has highlighted the importance of practical activities in science teaching. Study findings on practical activities in science education and experts made useful suggestions relevant to this study were given attention in the review.

The psychological and philosophical considerations of practical activities were also reviewed.

Thirdly, the need for practical activities in integrated science teaching was considered in this review. Since the focus of this study is on the relationship between performance in practical activities and students' academic achievement in integrated science at secondary school level, this area was also given attention in the review.

Fourthly, the implication of the review of literature for this study has been outlined, highlighted and focused in the course of this study.

On the whole, the entire review of the literature for this study has helped to bring together a number of related issues like the importance and relationship of practical activities to students' academic achievement among others and set a directive for the entire study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study is aimed at determining the relationship between students performance in practical activities and their practical activities and their academic achievement in integrated science using the NISTEP mode of teaching in junior secondary school level. In this chapter, the research design, the population, the sample and sampling techniques and procedure for analysis of data are presented.

3.2 DESIGN OF THE STUDY

Pre-test-Post -test experimental and control group (matched subject) design was used. Kerlinger (1973) Vandalen (1973) and Tuckman (1978) advocated the use of the matched subject design in a situation where two or more subject groups possess fairly the same or comparable relevant variables. In this study a pre-test was administered to both experimental and control groups. The tests were on practical skills and academic achievement. Later, in the course of study treatment was administered to the experimental group. This involves teaching them by the use of NISTEP mode of teaching, while the control group was taught by the lecture method. A post-test was administered to both groups after the teaching. The scores from the performance of experimental and control groups in the practical activities test and their corresponding scores from the academic achievement test were analyzed to determine the relationship between the

subjects scores in practical activities and those in their academic achievement. Also, the differences in the students' mean scores i,e, experimental group versus control group were determined.

3.3 POPULATION

The population for this study comprised all Junior Secondary School Classes III (JSS III) students in Sabon Gari Local Government Area of Kaduna State. These students were already exposed to integrated science progammes for at least two years. Their experiences in the use of Nigerian Integrated Science Project materials were expected to be fairly good. The junior secondary schools Sabon Gari Local Government Area comprise co-educational, mixed and single sex schools in one hand. On the other hand, they are also comprised of those that are government owned and others that are owned by voluntary agencies. A composite summary of these are given in Table 3.1

Table 3.1 The Schools in the Study Population

S\No	Name of School	School Statue	Location	Local Govt. Council	Male	Female	Total
1.	Govt. School Bomo	Male	Samaru	Sabon-Gari	342	-	342
2.	Govt. Girls Sec. Sch. Samaru	Female	Samaru	Sabon Gari	-	344	344
3.	Fed. Govt. Girls College Basawa	Female	Basawa	Sabon Gari	-	338	338
4.	Govt. Girls Sec. Sch. D/Bauchi	Female	Sabon Gari	Sabon Gari	-	347	347
5	Demon Sec. Sch. ABU	Co-Edu	Samaru	Sabon Gari	240	120	360
6.	Govt. Sec. Sch. Basawa	Co-Edu	Basawa	Sabon Gari	242	130	372
7	Govt. Sec. Sch. Chindit	Co-Edu	Sabon Gari	Sabon-Gari	159	221	380
8	Govt. Commercial College	Co-Edu	Sabon Gari	Sabon Gari	230	110	340
9	Therbow School	Co- Edu	Sabon Gari	Sabon Gari	143	163	306
			Total		**2066**	**1773**	**3239**

3.4 SAMPLE AND SAMPLING TECHNIQUES

The sample used for this study comprised of two co- educational secondary schools in Zaria metropolis. These schools are Demonstration Secondary School, A.B.U Zaria and Therbow Secondary School, Zaria. These students were selected by the use of simple random sampling technique using "drawing from the hat" method. This is because random sampling technique ensures that the different types of variables of interest in the population (e.g ,sex, class, types of school, and level of intelligence) in the school are fairly represented in sample.

In addition, the simple random sampling is adopted because it reduces the chances of sampling error and subjects within the population will be equally represented (Kerlinger, 1973). Shaiubu, (1981) and Abah, (1982) observed that simple random sampling techniques ensures that differences in subjects such as level of intelligence, social background and sex among others were evenly distributed.

The proportional representation of subjects in terms of gender is essential in testing hypotheses 2,3,5 and 6 in section 1.4 of chapter 1. The details of the study sample for this study is presented in table 3.2 below.

Table 3.2 Distribution of students in the sample schools.

Name of school	School status	Male (JS III) enrolment	Female (JS II) enrolment	Total of JSS III students	Groups
1. Therbow school	Co-Educational	78	50	120	Experimental Male Female 25 25
2.Demonstration Sec. Sch. A.B.U	Co-Educational	96	84	180	Control Male Female 25 25
TOTAL		166	134		50 50 100

The selection of the subjects for the study from each school was done randomly using drawing from the hat method. The selection was guided by the provision of the central limit theorem which purposes minimum of thirty students can be used for experimental study, Guildford (1965). Fifty students were randomly selected from each of the two schools selected. The total number of the subjects, therefore, was 100. This was considered reasonable and adequate as the representative of the population given the design of the study.

The subjects from Demonstration Secondary School served as the control group., while the subjects from Therbow Secondary School served as the experimental group. The detail distribution of subjects into experimental and control group is given in table 3.2 above.

3.5.0 TREATMENT

The Nigerian Integrated Science Teacher Education Project (NISTEP,1993), mode of teaching was used in teaching the experimental group, the topic selected are shown in section 3.6.1(see Appendix A. for the lesson notes). The researcher taught the experimental group in the school selected. The control group were taught the same topic by the researcher, but by the use of lecture method (see appendix B for the lesson notes.) each of the two schools was visited one after the other for the teaching purposes. Five weeks were taken for teaching of the experimental and control groups. A total period of 24 contact hours were used in teaching the two groups.

3.5.1 METHOD OF TREATMENT FOR THE EXPERIMENTAL GROUP

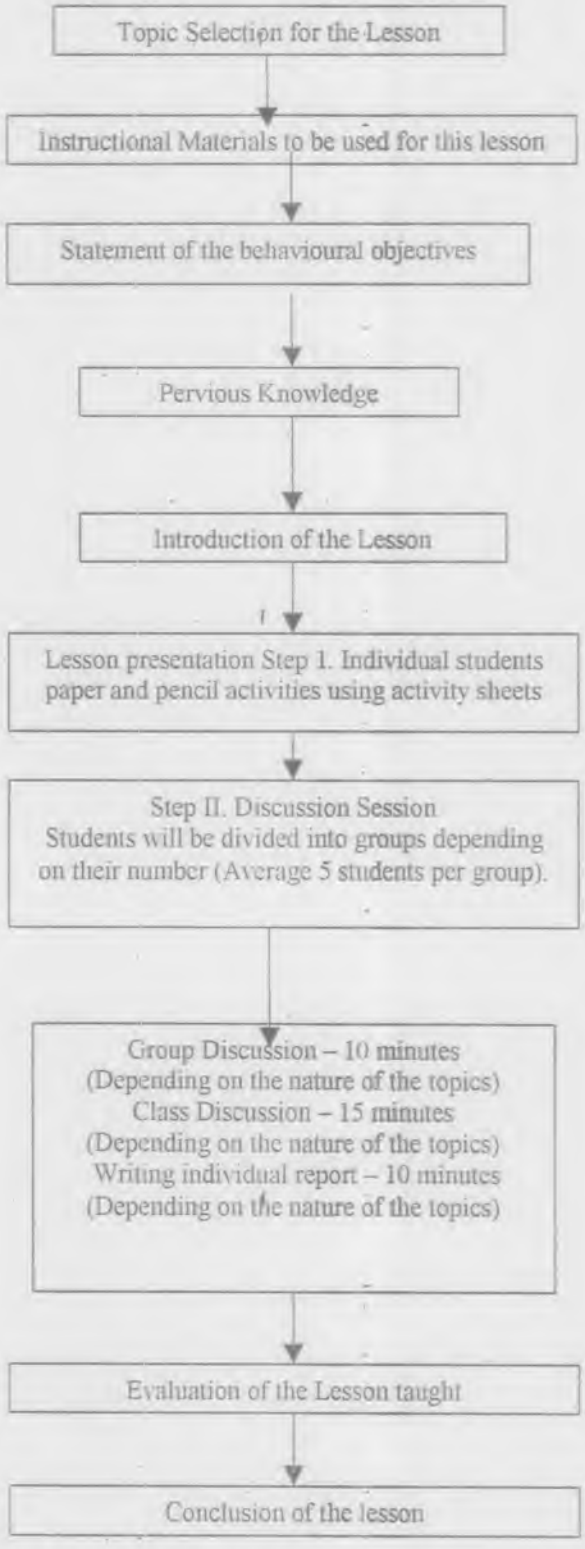
The treatment administered to experimental group was the NISTEP mode of teaching. The NISTEP mode of teaching was designed for the teachers trainers at NCE level. NISTEP mode of teaching emphasises paper and pencil or pen activity in situation where material and equipment are lacking or are insufficient or in science topics where practical activities cannot be readily organised in the teaching and learning of scientific concepts. Example of papers and pencils or pen actiovities of NISTEP is shown below;

1 Use of pictograph, charts, diagram and graph to discuss some scientific concepts, information among others.

2 Use of brain storming activity through group discussion session based on individual or group experiences.

3 Use of demonstration of some scientific concepts and skills, among others, for students to deduce the outcome of the event on their own.

The NISTEP mode of teaching described in section 1.2 of chapter one was used as the instructional procedure for the treatment. A flow chart of the mode as prescribed by the (NISTEP, 1993) is shown below:-



Flow Chart of NISTEP Mode of teaching.

Turton and NISTEP participants (1993)

3.6 INSTRUMENT DESIGN

3.6.1 SELECTION OF CONCEPTS

Prior to the selection of instruments to be used for this study, relevant integrated science topics were chosen for purpose of teaching and to guide instrument design. Nigerian Integrated Science Project (NISP) Pupils' Books III and Teachers' Guide of the same book were carefully studied. The topics selected were in line with paper and pencil or pen activity as stated in section 1.2.1 of chapter I.

The topics chosen are outlined in Table 3.3 below:

Table 3.3 Topics from Nigerian Integrated Science Project (NISP) Pupils, Textbook III Material (1985)

Chapter	Unit	Topic	Page
4	4	Feeding in Plants & Animals	27 – 35
9	4	Energy Conversions	57 – 63

Six lessons were taught and each lesson took 2 hours to complete for each group. Therefore, 12 hours were used for teaching the experimental group and 12 hours for teaching the control group.

The control group did not receive the treatment. Thus, it is assumed that any significant different in performances between the experimental and control groups can be attributed to the effect of the treatment administered.

3.6.2 TEST OF INTEGRATED SCIENCE PRACTICAL SKILLS (TOIPS)

The TOIPS instrument for this study followed the pattern used by Nay (1967), Mari (1995) and Ajagun (1998). Since the instrument is not adopted or adapted, therefore the TOIPS instrument needs to be validated, the reliability co-efficient and item characteristics were determined, these were achieved using data obtained from the pilot study (see Appendix C).

An example of the test items is as follows:

You are provided with a dry cell battery (1.5V), a flexible wire and a flashlight bulb (3V).

Connect the wires with the battery and bulb

a Write down what you notice.

b Touch the flashlight bulb what do you notice?

c Name the apparatus used and similar apparatus that can be used for this type of experiment.

d What conclusion can you draw from this experiment?

3.6.3 INTEGRATED SCIENCE ACHIEVEMENT TEST

Integrated science achievement test designed for JSS 3 students by Inyang (1988) was adopted. The 20 questions adopted from this instrument were based on the topics selected for this study (see appendix D). The topics are (i.) Feeding in plants and animals, and (ii.) Energy conversion. A typical question from Inyang Integrated Science Achievements Test (ISAT)adopted for this study is shown below -:

Which of this energy conversion takes place during a telephone conversation?

A Electrical → Sound → Electrical

B Sound → Electrical → Sound

C Chemical → Magnetic → Sound

D Sound → Magnetic → Sound

Inyang's Integrated Science Achievement Test has been standardized, thus there was no need for the researcher to this again for the items selected. For the details of the Integrated Science Achievment Test (ISSAT) see Appendix D. Inyang's instrument covered all the topics selected for this study. Therefore, all the 20 multiple choice questions selected were from Inyang's instrument.

VALIDATION OF TEST OF INTEGRATED SCIENCE PRACTICAL SKILLS (TOISP)

The test was validated by three senior lecturers teaching science education at Ahmadu Bello University, Zaria and three integrated science teachers from three secondary schools. The validators were requested to:

a Study the items and certify if the questions were considered to be testing the science practical skills they where meant to test.

b Certify if they appropriate for the level of students for which it is intended.

c To 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. Discrepaint items were re-written or dropped. On the basis of this, nine items testing the skills of prediction, hypothesis stating, inferring, communication, measurement, were dropped from the instrument. Most members of the panel felt that students of junior secondary school level would find it difficult to identify items testing the skill of hypothesis from prediction. It was also suggested that "communication" be left out as most items were conveying information, hence could easily confuse the subjects. Consequently, 40 items that met the criteria stated above were compiled and pilot tested so as to further ascertain the suitability of the instrument. Based on the result of the pilot study 30 items were selected for the final test of integrated science practical skills (see appendix C).

3.6.4 PILOT STUDY OF THE TEST ITEMS

A pilot study was carried out with a view to refine the test items. Two secondary schools were chosen for this purpose. These schools were Alhuda-huda College, Zaria and Government Commercial, Zaria. The total number of students involved in the pilot study was 60. The test-retest method was used. In each school a class comprising 30 junior secondary III students was used. The test was administered on two occasions with an interval of two weeks as suggested by Tuckman (1975). (See Appendix I for details).

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3.7 DETERMINATION OF TEST ITEM CHARACTERISTIC OF TOISPS.

a Facility Indices

The facility index of an item indicates the percentage of candidates that got an item right (Wood, 1990). The facility index of the items in the TOIPS was determined using the formula:

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

Where P = facility index

R = number of candidates who got the item right

T = Total number of candidates that attempted the item

Test items with facility indices in the range of 0.30 to 0.70 were used for this study. Oyebanji, (1978). Inomiesa (1978).

b Discrimination Indices

The discrimination index of a test is a measure of its ability to discriminate between high and low achievers in a test as whole. It is calculated using the formula:

$$D = \frac{R_U - R_L}{N/2}$$

Obtained by the top 27% and bottom 27% of the test. It is

Where D = description index

R_U = the number among upper 27%

R_L = the number among lower 27%

N = Total number of respondents.

Discrimination index ranges from 0.30 to 0.49 are described as moderately positive, those above 0.59 - 0.70 are high positive values while those 0.30 to 0.48 or below are low positive values (Furst, 1958). Thus following the recommendation of Furst on the use of discrimination indices for selecting items into the final form of a test, the test items with D value ranging from forms 0.30 to 0.75 were included in the test of integrated practical skills for this study. A combination of the facility indices and discrimination indices obtained for the test items determined the choice of the items that were included in the final version for the use.

c Reliability Co-efficient

Reliability coefficient of test of integrate science practical skills (TOISPS) was carried out using person production-moment correlation coefficient. On each of the test administration it took the students an hour to complete all the test items. The result of the correlation was r = 0.89. To further confirm the internal consistency of the test, the split -half procedure was also used. The coefficient of reliability obtained by this method was r = 0.86. The reliability coefficient is sufficiently high to consider test items as suitable for the study. (See appendix1).

3.8 ADMINISTRATION OF TESTS

The procedure used for administration of the tests in this study were as follows :

STEP I: PRE -TEST ADMINISTRATION

Two pre -tests were administered to the experimental and control groups. The two tests comprised of (i.) The two tests comprised of Integrated Science Practical; skills (TOISPS) and (ii). Integrated Science Achievement Test (ISAT). The test were administered to the subjects in the study sample. The pre -test scores were used to determine the equivalence or otherwise of the experimental and control groups. This was done by subjecting the mean scores of the two groups to t-test statistics. The result showed that there was no significant difference in the mean scores. Thus the two groups were considered equivalent in their academic abilities before treatment was administered. t- value 10.17 was calculated at $P \leq 0.05$ which indicates no significant different between the mean scores of the two groups (see Appendix I for detail).

STEP II: POST -TEST ADMINISTRATION

Two post-test were administered by the researcher after completion of the treatment. During the administration of the instruments the researcher distributed the Test of Integration Science Practical Skills and Integrated Science Achievement Test to the study subjects. The researcher allowed the subjects to

read through the written instruction on how to answer the test items on the question papers. The instructions were also explained verbally where necessary. The subjects were allowed 20 minutes for the Integrated Science Achievement Test (ISAT). This was based on the time suggested by Inyang whose instrument was adopted. The timing for the completion of Test of Integrated Science Practical Skills was based on the pilot study timing in which the completion of the test by the students was done in 60 minutes. Therefore, 60 minutes was used for the completion of the practical skill test. The students' scores from the tests and for the two groups (Experimental and Control) were recorded separately and used for the analysis.

3.9 PROCEDURE FOR DATA ANALYSIS

The data collected for this study were used to test the hypotheses stated in section 1.4 of chapter one. Each of the hypothesis is restated below along with the description of the statistical techniques. The level of significance for rejecting or retention of the stated hypotheses was set at $P \leq 0.05$.

NULL HYPOTHESIS 1

Students' performance in practical activities does not significantly relate to their academic achievements in integrated science at junior secondary school level by the use of NISTEP mode of teaching.

Correlation coefficient between the scores of students in practical activities and their academic achievement tests were computed using Pearson product -

moment correlation coefficient between the two scores in the variables (Guilford,1965).

NULL HYPOTHESIS 2

There is no significant relationship between the performance of junior secondary school male students in practical activity and their academic achievement in integrated science when exposed to NISTEP mode of teaching.

Correlation coefficient between the scores of male students in both practical activity and academic achievement test were computed using Pearson product- moment correlation coefficient between the two scores in the variables.

NULL HYPOTHESIS 3

There is no significant relationship between female students' performance in practical activity and their academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching.

Pearson product -moment correlation coefficient was used to correlate the scores of female students' performance in practical activity and their academic achievement in integrated science.

NULL HYPOTHESIS 4

There is no significant difference in the academic achievement of students taught using NISTEP mode of teaching and those taught with traditional lecture method in integrated science at junior secondary school level.

t-test statistical technique was used to test for any significant difference in the mean scores of the student in the experimental and control groups.

NULL HYPOTHESIS 5

There is no significant difference in the academic achievement of male and female junior secondary school students exposed to NISTEP mode of teaching in integrated science.

t-test statistical technique was used to test for any significant difference in the mean academic achievement scores of the male students of the experimental group.

NULL HYPOTHESIS 6.

There is no significant difference in the performance of male and female junior secondary school student in practical activity when exposed to NISTEP mode of teaching in integrated science.

t-test statistical technique was used to test for any significant difference in the mean practical activity scores of male and female students of the experimental group.

CHAPTER FOUR

DATA ANALYSIS, RESULT AND DISCUSSIONS

4.1 INTRODUCTION

This chapter contains the analysis, result and discussion of the result.

4.2 DATA ANALYSIS AND PRESENTATION OF RESULTS.

The analysis of data collected for the study was guided largely by the demands of the null hypothesis stated. Probability level ≤ 0.05 was used for rejecting or retaining the stated hypotheses. The Summary of the data analysed are shown in Appendix E.

The data were computer analysed using the SSP statistical package. The null hypotheses stated along with the results they generated are shown below.

NULL HYPOTHESIS 1

There is no significant relationship between students' performance in practical activity and their academic achievement in integrated science at junior secondary school level using the NISTEP mode of teaching.

To test this hypothesis, scores of the experimental group were collated from their practical activity performance. Also the corresponding scores from the achievement test were collated. These two sets of scores were then correlated using the Pearson product-moment correlation coefficient (r), to determine the relationship if any, between the two variables i.e. performance in practical activity and academic achievement. This is shown in Table 4.1.

TABLE 4.1 CORRELATION COEFFICIENT BETWEEN PRACTICAL ACTIVITIES SCORE AND ACADEMIC ACHIEVEMENT SCORES OF THE EXPERIMENTAL GROUP

Variable	N	DF	r Calculated	r Critical	p	Remark
Practical Activities	50	48	0.75	0.27	0.000	Significant
Academics Achievement	50					

From the result in Table 4.1, the calculated r-value of 0.75 obtained is greater than the critical value of 0.27. This showed that there is significant relationship between students' performance in practical activity and their academic achievement. This meant that a student who performed well in practical activity may also be expected to perform as well in their academic achievement tests when exposed to NISTEP mode of teaching. This null hypothesis stated is, therefore, rejected.

NULL HYPOTHESIS 2

There is no significant relationship between male students' performance in practical activity and their academic achievement when exposed to NISTEP mode of teaching. The practical activity and academic achievement scores of the male students from experimental group were correlated using Pearson product-moment correlation coefficient statistical technique (r) to determine if there is any relationship between the two variables. The result is shown in Table 4.2.

Table 4.2 RELATIONSHIP BETWEEN MALE STUDENTS' PERFORMANCE IN PRACTICAL ACTIVITY AND THEIR ACADEMIC ACHIEVEMENT

Variable	N	DF	r Calculated	r Critical	p	Remark
Male Practical Activity. Performance	25	23	0.62	0.39	0.000	Significant
Male Academic Achievements	25					

From the result in Table 4.2, the calculated r-value of 0.62 was obtained and is greater than the critical value of 0.39 at $P \leq 0.05$. This shows that there is significant relationship between the male students' performances in practical activity and their academic achievement using NISTEP Mode of Teaching. The null hypothesis stated is thus rejected.

NULL HYPOTHESIS 3

There is no significant relationship between Female students' performance in practical activity and their academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching.

To test this hypothesis, the scores of female students of the experimental group were collated from their practical activity as well as the scores from their academic achievement test these were correlated again using the Pearson

product-moment correlation coefficient statistical technique(r). The result of the correlation is shown in Table 4.3.

TABLE 4.3 CORRELATION COEFFICIENT BETWEEN FEMALE STUDENTS' SCORES FROM PRACTICAL ACTIVITY PERFORMANCE AND ACADEMIC ACHIEVEMENT

Variable	N	DF	r Calculated	r Calculated	P	Remark
Female Practical Achievement	25	23	0.76	0.39	0.000	Significant
Female Academic Achievement	25					

From the result in Table 4.3, the calculated r-value of 0.76 was obtained and is greater than the critical value of r=0.39. This shows that there is significant relationship at $P \leq 0.05$ between the performance in practical activity and academic achievement of the female students when exposed to NISTEP mode of teaching. The null hypothesis is thus rejected.

NULL HYPOTHESIS 4

There is no significant difference in the academic achievement mean scores of students taught with NISTEP mode of teaching and those taught with traditional lecture method in integrated science at junior secondary school level.

To test this hypothesis, scores of students from the academic achievement test of the experimental and control groups were collated. These were then analysed using t-test statistical technique to find out if the differences in the mean scores between the two groups are statistically significant at $P \leq 0.05$.

The results are shown in Table 4.4

TABLE 4.4 **COMPARISON OF THE ACADEMIC ACHIEVEMENT SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS.**

Variable	N	$\bar{x}$	SD	SE	t-value Calculated	DF	t –value Critical	P	Remark
Experimental Group	50	14.90	3.32	0.43	11.77	98	1.98	0.000	Significant
Control Group	50	6.02	3.01	0.41					

From the result in Table 4.4, the calculated t-value of 11.77 was obtained. This is greater than the critical t-value of 1.98 at $P \leq 0.05$. This indicates that there is a significant difference between the performance of students exposed to NISTEP mode of teaching compared with those exposed to traditional lecture method of teaching. This shows that NISTEP mode of teaching enhances students' academic achievement. Thus, the null hypothesis is also rejected.

NULL HYPOTHESIS 5

There is no significant difference in the mean scores of the academic achievement of male and female junior secondary school students in integrated science when exposed to NISTEP mode of teaching.

To test this hypothesis, the academic achievement means scores of male and female subjects in the experimental group were collated. The mean scores from the two sources were then analysed using the t-test statistical technique, to test for any significance difference in the mean scores of the two groups. The result is presented in table 4.5

TABLE 4.5 **COMPARISON OF THE PERFORMANCE OF MALE AND FEMALE STUDENTS IN ACADEMIC ACHIEVEMENT .**

Variable	N	$\bar{X}$	SD	SE	t-value Calculated	DF	t –value Critical	P	Remark
Experimental Group	25	13.80	14.81	0.56	1.16	48	2.01	025	Not Significant
Control Group	25	13.70	15.03	0.63					

From the result in table 4.5, the calculated value t-value of 1.16 is lower than the critical t-value of 2.01. This shows that there is no significant difference at $P \leq 0.05$ confidence level between male and female students' academic achievement when exposed to NISTEP mode of teaching. Thus, the null hypothesis is retained. This indicates that gender does not seem to play a significant role in the academic achievement of students when exposed to the NISTEP mode of teaching.

NULL HYPOTHESIS 6

There is no significance difference in the performance of male and female junior secondary schools students in practical activity when exposed to NISTEP mode of teaching in integrated science.

To test the stated hypothesis, the practical activity mean scores of the male and female students in the experimental group were collated. The scores were than analysed using t-test statistics and the result is shown in table 4.6 below.

TABLE 4.6 COMPARISON OF THE PERFORMANCE OF MALE AND FEMALE STUDENTS IN PRATICAL ACTIVITY.

Variable	N	$\bar{x}$	SD	SE	t-value Calculated	DF	t –value Critical	p	Remark
Male	25	14.01	4.30	0.84	0.61	48	2.01	0.54	Not Significant
Female	25	14.80	3.34	0.62					

From the result in table 4.6 the calculated t-value of 0.61 was obtained and is low than the critical t-value of 2.01. This shows that there is no significant difference in the male and female students' performance in practical activity when exposed to NISTEP mode of teaching. The stated null hypothesis is therefore retained. This indicates that gender has no significant effect on the students' performance in practical activity when exposed to NISTEP mode of teaching.

4.3 DISCUSSION OF THE RESULTS

The data collected for the present study were based on the performance of the subjects in the practical activity and their corresponding academic achievement scores. These were analysed according to the demand of the research questions, hypotheses formulated and the designs of the study. The discussions of the results are as follows:

Question One

Does the students' performance in practical activity relate significantly to their academic achievement in integrated science at junior secondary school using NISTEP mode of teaching?

The result in Table 4.1 revealed that students' performance in practical activity relates significantly to their academic achievement when exposed to NISTEP mode of teaching. There was statistically significant relationship between the two variables at $P \leq 0.05$ significant level.

Compared with the previous results of studies the present study agrees with the findings of Muazu (1983), Kempa (1986), Lock (1987), Bichi (1988) and Mari (1994), who stated that practical activity performance of students is related to their academic achievement in science. The result, however, disagrees with the findings of Hemstead (1973), Saadeh (1973) and Abraham (1980) who stated that students' performance in practical activity do not relate to their academic achievement in science. The disagreement could be attributed to the higher level of students (Senior secondary) used, if lower level of such students were used as

in the case of this study, the findings, could have been the same. the use of paper and pencil practical activities within the NISTEP mode of teaching is thus, a relatively cheap method enhancing learning of integrated science at the junior secondary school level.

Question Two

Is there any significant relationship between the performance of male students in practical and their academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching?

As far as the present study is concerned, the results in respect of male students as shown in table 4.2, indicates that there was significant relationship at $P \leq 0.05$ between male students performance in practical activity and their academic achievement when exposed to NISTEP mode of teaching. This finding is in agreement with previous findings of Ogunyemi (1973), Ibeme(1975), Jegede (1981), Woolnough (1985), whose results revealed that male students' performance in practical activity is related to their academic achievement in science. In other dimension the finding disagree with those of Hemstead. (1973), Saadeh (1973) and Abraham (1980) which says that performance of students in practical activity do not relate to their academic achievement in science This could be as a result of the instructional strategy used in teaching the students in their studies which was discovery method of teaching. This does not give enough room for peer – group interaction as in the case of NISTEP mode of teaching

employed in this study further goes to strengthen the earlier findings of Ogunyemi (1973), Ibeme (1975), Jegede (1981) and Woolnough (1985).

Question Three

Does the performance of female students in practical activity relate to their academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching?.

From the result shown in table 4.3 there was significant relationship between the female students' performance in practical activity and their academic achievement when exposed to NISTEP mode of teaching at $P \leq 0.05$.

This result from the present study agrees with the studies of Terman and Tyler (1954), Dale (1962), Wisenthal (1965) and Mari(1994) whose studies revealed that female students' performance in practical activity is related to their academic achievement in science. This disagrees with the findings of Comber and Keeves (1973) and Ibeme (1975). This disagreement could be due to the instrument used to assess the students' academic achievement in their studies which was teacher-mode test which was mainly on product –based assessment. If a standardized process and product based assessment was utilized as in the case of the study, the result could have been the same. the significant relationship in this study can be attributed to the treatment administered which is NISTEP mode of teaching.. It shows that the mode is effective in enhancing students' academic achievement when used appropriately. It further strengthens the general belief that practical activities help to promote academic achievement.

Question Four

Does exposure to NISTEP mode of teaching enhance junior secondary school students' academic achievement in integrated science compared to the traditional lecture method?.

The result in Table 4.4 revealed that students exposed to NISTEP mode of teaching performed significantly better in their academic achievement in integrated science at junior secondary school than those exposed to traditional lecture method of teaching . The t-value of 11.7 showed a statistically significant difference between the performances of those exposed to NISTEP mode of teaching and those exposed to lecture method at $P \leq 0.05$. This finding disagrees with those of Hemistead (1973) and Driver (1988) which stated students exposure to practical activities may not necessarily enhance their academic achievement in science.

This disagreement could be attributed to the higher level of students used for their studies. If a lower student (junior secondary) were used as in the case of this study, the result could have been the same. This findings in aagreement with those of Ileoge (1981), Watson and Prieto (1995) which stated that practical activities enhanced students' academic achievement in science. This result thus show a justification, for the NISTEP mode of teaching integrated science at junior secondary school level.

Question Five

Do male and female students benefit equally from NISTEP mode of teaching?

That is, is there gender-related difference in students' academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching?

As far as the present study is concerned the result in respect of male and female students' academic achievement as shown in table 4.5, indicates that there was no significant difference statistically between male and female students' mean scores in academic achievement when exposed to NISTEP mode of teaching at $P \leq 0.05$. This finding is in agreement with those of Nwachukwu (1982), Daramola (1983) and Inomiesa (1985) while it disagrees with the findings of Dale (1962) Iyang (1988) and Mari(1994). This disparity could be as a result of the instrument used for the assessment of students' academic achievement. This was a teacher – mode test; which focussed mainly on lower level of Bloom. et al (1956) cognitive domain. If a standardized instrument was used as in the case of this study, the result could have been the same. A major import of this finding is that the NISTEP mode of teaching is gender – friendly.

Question Six

Do male and female students perform equally well in practical activities when exposed to the NISTEP curriculum in junior secondary school integrated science?

From the result in table 4.6 there was no statistically significant difference between the performance of male and female students in practical activity when exposed to NISTEP mode of teaching in junior secondary school integrated science. This result from the present study agrees with the studies of Nwachukwu (1982), Dale (1983) and Inomesa (1985) which revealed that male and female do not differ in their practical activity performance in science.

The result disagree with the finding of Ogunyemi (1973)and Jegede (1981) which revealed that there was gender difference in students' performance in practical activity in science. This disagreement could be attributed to the higher level of students used in their studies (Senior Secondary School).

If lower of such students were used as in the case of this study, the result could not have been different. The significant difference and significant relationship of students' performances in practical activities and academic achievements in this study can, therefore, be attributed to the treatment administered; The result further shows that the NISTEP practical activities are suitable amenable to the learning requirements of both boys and girls in Integrated Science at Junior Secondary School level.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter, the summary of the research problem, procedure used as well as the findings from the study are presented. The limitation of the study and the recommendations arising from the findings and those fruitful for further research are made.

5.2 SUMMARY

This study is aimed at determining the relationship between students' performance in practical activity and their academic achievement in integrated science at junior secondary school using NISTEP mode of teaching. The study was carried out using secondary school pupils in Zaria metropolis , in Sabon Gari Local Government area of Kaduna state. The sample which was obtained by random sampling technique comprised of 100 subjects of junior secondary school level.

Through appropriate review of literature, relevant information were gathered about previous studies, related to the study. This helped a lot towards streamlining and guiding the focus of the study.

The researcher instruments used were:

a Integrated Science Achievement test (ISAT)

b Test of Integrated Science Practical Skills(TOISPS)

The instruments were administered to the 100 subjects comprising 50 students for control group and 50 students for the experimental group randomly assigned to the groups.

The data collected were analysed with the aid of computer using the SSP statistical package.

5.3 SUMMARY OF FINDINGS

1 There was significant relationship between students' performance in practical activity and their academic achievement in integrated science when exposed to INSTEP mode of teaching. A correlation of 0.75 was obtained at $P \leq 0.05$. This finding has answered the stated research question No. 1,

2 There was significant relationship between the performance of male students in practical activity and their academic achievement in integrated science when exposed to NISTEP mode of teaching. This finding has answered the stated research questions No2.

3 There was significant relationship between female students' performance in practical activity and their academic achievement in integrated science using INSTEP mode of teaching. Correlation coefficient of 0.76 was obtained at $p \leq 0.05$. This finding has answered the research question No.3.

4 There was significant difference in the academic achievement mean scores of the experimental and the control groups. The experimental

group, expose to the NISTEP mode of teaching performed significantly better than the control group that had no such treatment. The t-test statistics gave t- value 11.77 at $P \leq 0.05$. This finding answered the stated research question No.4.

5 There was no significant difference in mean academic achievement scores of male and female students exposed to NISTEP mode of teaching in integrated science. A t-value of 1.16 was obtained at $P \leq 0.05$. This value was not statically significant. This finding answered the stated research questions No.5.

6 There was no significant difference in the mean score of male and female students in practical activity when exposed to NISTEP mode of teaching in integrated science. A t- value of 0.62 was obtained at $P \leq 0.05$.This result indicates that gender is not a significantly important factor in students' achievement in integrated science when the NISTEP mode of teaching is used. This findings answered the stated question No.6

5.4 IMPLICATION OF THE FINDINGS FOR SCIENCE EDUCATION

The problem that prompted this study is partly the poor academic achievement of students as it relates to integrated science teaching and learning at junior secondary school level of education. Poor academic achievement of students as observed by Olarinoye (1970), Jegede (1981), Mani (1981), Inyang(1988), has been attributed to so many factors, some of which include the constant use of traditional lecture method of teaching. Lack of students' direct

involvement in practical activities and lack of qualified integrated science teachers among others.

The result of the present study have shown that the use of NISTEP mode of teaching at junior secondary schools has the potential to enhance students' academic achievement as well as their performances in practical activity. It is important for integrated science teachers to improve on their methods of teaching integrated science by employing a practical- activity oriented method in their teaching, one of such method of teaching is NISTEP mode of teaching. This method allows active involvement of the students in the teaching / learning process through the provision of activities that enhance exchange of ideas, experiences, social interaction and initiative among others. Also the use of NISTEP mode of teaching, as shown in this study ,enhances the learning of science. It can be deduced that the method caters for both the product and the process aspects of science teaching and learning.

On the issue of gender differences in science education the, present study revealed that, if both male and female students are exposed to NISTEP mode of teaching they will perform equally well. This implies that practical- oriented mode of teaching and learning science as exemplified by NISTEP approach will help to minimize effects of gender differences in science classroom. This may help to resolve the gender issue as they affect the teaching and learning of science.

On the issue of relationship between students' performance in practical activity and their academic achievement when exposed to NISTEP mode of teaching, the present study revealed that there was significant relationship. This

has an important implication in the sense that it gives an empirical support for the general practice of incorporating practical activities into science teaching and learning in schools. It strengthened the validity of the belief, sometimes held subjectively by teachers, that inclusion of practical activities into learning of science helps to enhance student' achievement.

5.5 CONCLUSIONS

From the findings of this study the following conclusions are made:

1. Students' exposed to NISTEP mode of teaching performed significantly better in practical activity and in academic achievement in integrated science, compared to those exposed to the traditional lecture method of teaching and learning science.
2. The performance of male and female students do not differ significantly in practical activity and academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching.
3. There was significant relationship in the performances of female students in practical activity and academic achievement in integrated science at junior secondary school level when exposed to NISTEP mode of teaching.
4. Performance of boys and girls in practical activities and academic achievements were significantly better when exposed to NISTEP mode of teaching in integrated science at junior secondary school level.

5.6 RECOMMENDATIONS

From the findings o f this study the following recommendations are made:

1 The use of NISTEP mode of teaching should be encouraged in the teaching and learning of integrated science at junior secondary school level.

2 Teachers handling integrated science lessons at junior secondary should be trained in the use of practical oriented methods as exemplified by the Nigerian Integrated Science Teacher Education project mode of teaching. Thus the federal ministry of education and the state ministries of education are called upon to make provision for such training. This could be done by using similar procedures employed by the Nigerian Integrated Science Teacher Education Project (NISTEP).This include workshops at the Institute of Education, Ahmadu Bello University, Zaria, in collaboration with tertiary institutions, the secondary schools and professional organizations.

3 In an effort to train integrated science teachers on the use of NISTEP mode of teaching Federal Ministry of education and State Ministries of Education should revitalize NISTEP program at various levels of education. This could be done using resource personnel already trained in this aspect by liaising with resource persons in Institute of Education and Department of Education of Ahmadu Bello University, Zaria, Federal College of Education and some staff in Educational Resource Centres in their respective states.

4 Science educators and curriculum designers should evaluate the teaching of integrated science at junior secondary school form time to time in an effort to incorporate NISTEP mode of teaching into integrated science teaching and learning process, and also to keep in focus the effectiveness of the approach with the passage of time.

5.7 LIMITATIONS OF THE STUDY

1 The schools used for this study are private institutions. Other types of schools such as Government schools owned by Federal or State Ministries of Education had not being included. This was because these schools are not co-educational as such, boys and girls in these schools are taught separately. Since the study dealt with gender as part of variables to be tested, the stated schools were not included. This may affect the scope of generalization made on the finding as it affects the population of the study.

2 Students used for this study are not quite familiar with NISTEP students' activity sheets. A lot of explanations and orientations were done to acquaint the subjects with the NISTEP mode of teaching/learning. This tended to affect the time duration as well as lesson procedures during teaching and learning process. This might affect students' performance in practical activities as well as their academic achievement as it represented a factor that was difficult, if not impossible for the researcher to control.

5.8 SUGGESTIONS FOR FURTHER STUDIES.

1 There may be need to replicate the study at other states and nation wide so that the validity and scope of generalization made in this study can be strengthened.

2 Attitude of integrated science teachers and students at junior secondary school towards NISTEP mode of teaching should be investigated to find out if they are favourably disposed to teaching it in the first place.

3 Studies should be carried out on the effect of NISTEP mode of teaching at tertiary level to see if similar result can be obtained. This is so, because the teachers that teach at the junior secondary school level are trained at the tertiary level.

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APPENDIX A

LESSON NOTES FOR EXPERIMENTAL GROUPS

Lesson note: 1

Mode of teaching - NISTEP

Lesson topic: - Energy Conversion

Time Double Period (80 minutes)

Class : JS III

No. of pupils : 40

Topic : Types of Energy and their Conversion

INSTRUCTION MATERIALS : Candle, Torchlight, Dry cell Battery, Electric bell, Electric pressing iron, Telephone machine, Student activity sheets.

BEHAVIOURAL OBJECTIVES : By the end of the lesson students were able to :

a. Define energy.

b. List at least 5 types of energy.

c. Explain the sources of energy mentioned above.

d. Identify energy conversion from one form to another.

e. Perform some simple experiments on energy conversion.

PREVIOUS KNOWLEDGE:- Students have been applying energy in one form to another for their day - to - day activities e.g. Torchlight, Candle, math stick, electric fan etc.

INTRODUCTION; - The teacher asked the students the following questions

a. Mention at least 5 instruments or appliance in your houses.

b. Explain the functions of any two of the appliance.

PRESENTATION OF THE LESSON

The students were divided into 5 groups of 8 students each to carry out the following activities. (see the activity sheet after this lesson note)

STEP I: Activity sheet 1 were provided to the students as :-

Activity sheet 1.1 forms of energy.

The students were instructed to carry out the activities as provided in the activity sheets.

STEP II : Activity 2 Energy conversion.

Students were instructed to carry out the activities provided in the activity sheets.

STEP III : Discussion and writing find result. Session.

The students of each group wrote their report and submitted to their group for discussion as follows

Group discussion 5 minutes

Class discussion 10 minutes

Writing individual report 20 minutes.

EVALUATION : The teacher evaluated the lesson by asking the students the following questions:

a What is energy ?

b List at least five types of energy and their sources.

c Using the apparatus/appliance provided trace the energy conversion taken place in them by conducting simple experiments with them.

CONCLUSION :- The teacher concluded the lesson by briefly summarizing what the students have learnt, such as types of energy, energy conversion and inform the students that their next lesson will be on application of energy.

STUDENTS' ACTIVITY SHEET I

Activity 1 time 40 minutes.

Energy is the ability to do work or capacity of doing work. For example a moving car can work because it has energy. A man talks, move because he has energy. This energy comes in different forms.

Activity 1 Forms of energy.

There are various forms of energy some of which are, chemical energy, light energy, electrical energy, heat, sound and potential energy.

A. Observe the following objects and state the type of energies they posses.

Object	Types of energy posses
1. Match stick	
2. Candle	
3. Torchlight	
4. Dry cell Battery	
5. A hanging mango	
6. Electric pressing iron	
7. Telephone	
8. Electric bell	

B Mention other types of materials apart from those stated above with type of energy they possess.

C What do you think is the major primary source of all forms of energy ?

D The energy animals used for their day - to day activities come from _____ energy.

E The energy used when starting a motor cycle is called _____ energy.

F A moving bicycle is using _____ energy.

G When a child is trying to jump from the top of high table the child possess _____ energy.

STUDENTS' ACTIVITY 2

Activity 2 Time 40 minutes

Topic : Energy conversion.

As you have learnt from your previous lesson energy exist in various forms. This energy formation can be converted to one form to another.

Activity 2.1 Changing potential energy to kinetic energy.

Consider these questions : A mango falls from the branch to the ground as shown in fig. 2.1 below. What energy had it before it left the branch ?



Fig 2.1 A Falling Mango.

What energy had it just before it hits the ground ? what has become of this energy when it hits the ground ? Trace the energy conversion of the above questions. By filling in correct type of energy below :-

Energy ⟶ Energy ⟶ Energy

Place a piece of stone on a table and gently push the stone so that it falls to the ground. Trace the energy conversion that takes place.

Energy ⟶ Energy ⟶ Energy

Activity 3.1 Chemical Energy to Electrical Energy to Light and Heat Energy

A. You are provided with the following apparatus :

A dry cell battery

A flexible wire

A flash light bulb

B. Connect the flexible wire with the battery provided and connect them again to a flash light bulb as in fig. 3.1

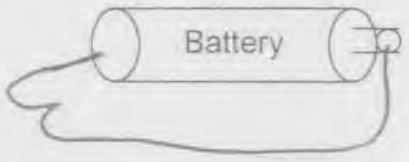


Fig 3.1 A simple circuit

Trace the energy conversion that takes place in the above experiment as follows

energy ⟶ energy ⟶ energy ⟶ energy

Give two examples of two activities of your own that can produce the type of energy conversion stated above

(1) (2)

Activity 4.1 Changing Kinetic energy to Heat energy.

Rub your palm together for about a minute what happen?

_____

Trace the energy conversion taken place on the above exercise.

Energy ⟶ energy ⟶ energy ⟶ energy

You are provided with an empty can (peak milk can) rub this on the ground for about a minute. What happens ?

_____

Trace the energy conversion taken place

energy ⟶ energy ⟶ energy

Activity 4.1: Heat energy to Light energy

Heat a piece of strong iron wire in a flame on Bunsen burner. What happens ?

Trace the energy conversion of the above exercise.

energy ⟶ energy ⟶ energy

Activity 4.2. Electrical energy to Mechanical to Sound.

A. Connect an electric bell with battery through a switch. Press the switch. What happens ?

Trace the energy conversion taking place

energy ⟶ energy ⟶ energy

Give an example of this type of energy conversion of your own.

Activity 4.3 Kinetic to Sound energy

Think of man beating a drum. what happens?

Trace the energy conversion taking place.

⟶ Energy ⟶ Energy ⟶ energy

Activity 4.4 Changing Kinetic Energy to Sound Energy

You are provided with an empty can (e.g empty tin of bournvita etc) and iron nails. Put the iron nails inside the can and shake. What happens?

Trace the energy conversion taking place.

⟶ Energy ⟶ Energy ⟶ Energy

Give an example of this type of energy conversion on your own.

LESSON NOTE 2 (For experimental group)

Method of Teaching : NISTEP mode of teaching

Subject : Integrated Science

Lesson 2 Unit 2

Unit title : Energy conversion

Time : double period (80 minutes)

No. of pupils : 40

Topic : Application of energy conversion.

INSTRUCTIONAL MATERIALS: Dry cell battery, Radio set, Bicycle, electric pressing iron, Tape recorder, television set, telephone machine, Electric fan, Electric heater, etc.

BEHAVIOURAL OBJECTIVES : by the end of the lesson students were able to :

a. Trace the types of energy conversion taken place in the appliances provided

b. Explain the importance of energy to life to our day – to – day activities.

c. Give at least five examples of other energy conversion application apart from those used in this lesson.

PREVIOUS KNOWLEDGE: Students have learnt about types of energy conversion in the previous lesson.

INTRODUCTION : The teacher asked the students the following questions :

a. Mention at least five types of energy.

b. Explain energy conversion that takes place in any of the apparatus of your choice.

c. State the importance of energy conversion application to our day - to – day activities.

PRESENTATION OF THE LESSON

The lesson was presented by given the students some activity sheets in their various group : as follows (See the students' activity sheets after lesson note).

STEP 1: Activity 5.1 Application of the energy conversion. The bicycle

The students were provided with activity sheets and they were instructed to carry out activity in the sheet provided.

STEP II: Activity 5.1 Application of the energy conversion : Domestic appliances.

Students were instructed to carry out the activities provided in the activity sheets

STEP III : Discussion and writing final report session.

The students from each group submitted their results in each activity to their group for discussion as follows :

a. Group discussion 5 minutes

b. Class discussion 10 minutes.

c. Writing individual final result. 10 minutes

EVALUATION The teacher evaluated the lesson by asking students the following questions:

a. Explain the energy conversion taken place in a moving bicycle.

b Trace and explain the types of energy conversion applied in 5 of the household materials

CONCLUSION The lesson was concluded by briefly summarizing what the students have learnt in this lesson for example application of energy conversion in a moving bicycle and application of energy conversion to our domestic appliances.

Students activity sheet

Activity 6.1 Time : 40 minutes.

Activity on energy conversion

The energy conversion you learnt, have very important uses in our environment. Therefore, it can be applied in various domestic uses in our homes, offices, roads e.t.c.

Activity 6.2 : The bicycle

A boy riding a bicycle is converting one form of energy to another. Can you fill in the energy conversion taken place ?

Chemical energy ⟶ energy ⟶ energy

If the bicycle has a dynamo attached to it, the head camp of the bicycle is lit as the pedal are turned. Trace the energy taken place in the process.

⟶ energy ⟶ energy ⟶ energy

Activity 6.3: Application of energy conversion

Think of the following instruments trace the energy conversion that take place in them.

a. Pressing iron

b. Radio set

c Tape recorder

d Television set

e A telephone

f Kerosene cooking stone

g Electric cooking stove

h An electric heater

I An electric fan

j Can you think of other appliances similar to the above instrument ?

---

i. List at least two of such materials.

ii. Trace the energy conversion in them

LESSON NOTE (3)

Group Experimental

Method of Teaching : NISTEP mode of teaching

Lesson 3 Unit 1

Unit title : Feeding in plants and animals

Time : Double period (80 minutes)

No. of pupils : 40

Topic : method of feeding in animals.

INSTRUCTIONAL MATERIALS : Specimens teeth, students' activity sheets

BEHAVIOURAL OBJECTIVES : By the end of the lesson students were able to

a. Mention 4 types of teeth found in animals' mouthpart as mammals.

b. Identify each type of teeth with their functions

c Define the word dentition

d. Describe what dental formula is :

e State at least 3 types of feeding in mammals.

PREVIOUS KNOWLEDGE: Students have been using their teeth during and are familiar with what their teeth are

INTRODUCTION: The teacher introduced the lesson by asking the students the following questions.

a Describe the action of your teeth when you are taking a piece of yam into your mouth.

b Describe how a cow feed on the grasses

PRESENTATION OF THE LESSON ;

After dividing the students into groups of 8 students each. the lesson was presented using the following activity sheets. (See the students' activity sheet after this lesson note)

STEP I : Activity 6.1

Adaptation of mouth part for feeding.

The students were instructed to carry out activities on the sheet provided. Their answers were submitted to the group for discussion.

STEP II : Activity 6.2

Dental formula

The students were provided with activity sheet 6.2. They were instructed to carry out the activities on the sheets. The students' answer were submitted to the group for discussion.

STEP III : Discussion and writing of the report session

The result of the students submitted to each group were discussed as follows:

Group discussion 5 minutes.

Class discussion 10 minutes

Writing individual final result.

EVALUATION: The teacher evaluated the lesson by asking students the following questions

a Mention 4 types of teeth discussed within the lesson

b State their functions in relation to their shapes.

c What is dentition and give an example of dental formula.

d Define dental formula and give example of dental formula.

e State the types of method of feeding in mammals.

CONCLUSION : The lesson was summarized as follows ; in this lesson the dentition, the dental formula, types of feeding in mammals, were discussed. The next lesson will be on type of feeding in insect.

Students' Activity sheet : 6 Method of feeding in Animals :

Activity 6.1 adaptation of mouth part for feeding.

Certain parts of the bodies of animals are specially suited for feeding. Consider your mouth and your jaws. In the mouth you have teeth. Without them you would find it very difficult to eat the kind of food you do, such as meat and hard fruits.

EXERCISE : Observe the mouth part of your neighbour and look at the type of teeth found there.

Are all the teeth the same ?

The front teeth are called **Incisors.** Draw the type of teeth.

The next teeth to the incisors are called **Canines**. Draw this type of tooth.

Next to the canine come the **Premolars**. Draw the structure of a premolar tooth.

Further back still you have the **Molars**. Draw the structure of the molar tooth.

Count the number of each type of teeth observed on the upper jaw.

Types of teeth	Number in the upper jaw Incisors
Canines	
Premolars	
Molars	
Total	

To have the complete set of teeth you are to multiply the total of teeth above by two. What number will you get from an adult person altogether ?

The number and arrangement of teeth is called the **Dentition.**

Activity 6.2. Dental formula ; 30 minutes.

To save a lot of writing when describing the dentition of mammals, we are describing the dentition of mammals, we represent the number of teeth that an animal has and their types by what is called a Dental formula.

Complete the following activities on the dental formula of an adult man.

Alphabet	Name of tooth	No. on each Jaw	No. of half side
I			
C	Canine	2	1
P			
M			
Total			

When you observe the teeth of your neighbour, you will see that the right hand side should be the same as he left. We only write down the formula for one side. This applied to both the upper and lower jaw as observed in the above exercise.

Activity 6.3

Use the above table and write down the dental formula of an adult man

$$I\frac{2}{2} \quad C\frac{1}{1} \quad P\frac{2}{2} \quad M\frac{3}{3}$$

Activity 6.4

The cat has the following dental formula

$$I\frac{3}{3} \qquad C\frac{1}{1} \qquad P\frac{3}{2} \qquad M\frac{1}{1}$$

What is the total number of teeth found in the above dental formula ?

An animal that feeds on flesh is called

A cow has the following dental formula

$$I\frac{0}{0} \qquad C\frac{0}{1} \qquad P\frac{3}{3} \qquad M\frac{3}{3}$$

Interpret the dental formula above

Why is it that the cow has more premolars than the cat ?

What kind of food does cow feed mainly on ?

List the name of the other 2 animals that feed like cow.

(1) (2)

What is herbivores ? (Used the type of food mainly eaten by cow to answer this question)

Compare your mode of feeding with that of carnivores and herbivores and explain the type of food you feed on ?

This mode of feeding is called ?

Give example of an animal that feed like you.

LESSON NOTE 4

Group : Experimental

Method of teaching : NISTEP mode of teaching.

Subject : Intergrated Science

Lesson 4 Unit 2

Unit title : Feeding in plants and animals

Time : Double period 980 minutes)

No. of pupils : 40

Topic : Methods of feeding in insects.

INSTRUCTIONAL MATERIALS : Specimen of grasshopper. Housefly. Glass jar and Sugar and students' activity sheets.

BEHAVIOURAL OBJECTIVES :By the end of the lesson students will be able to.

a Describe the method of feeding of grasshopper.

b Describe the structure of the mouth part of grasshopper

c Describe the method of feeding in housefly.

d Compare the structure of the mouth of housefly with that of grasshopper

PREVIOUS KNOWLEDGE : The students have learnt about method of feeding in mammals in their previous lesson e.g. man , cow, cat.

INTRODUCTION: The teacher introduced the lesson by asking the students the following question.

1 What do you understand by dentition ?

2 Describe the mode of feeding in cow.

PRESENTATION OF THE LESSON

The lesson was presented after grouping the students into 8 groups of 5 students each as follows

STEP I : Activity 6.5 Method of feeding in insect

The students were instructed to carry out the activities on the activity sheets provided and submit answer to their groups fro discussion (see student's activity sheets after this lesson note)

STEP II: Activity 6.6

The mouth part of grasshopper

Like the above procedure in step I students were provided with activity sheets 6.6 they were instructed to carry out the activities in the activity sheets and submit their results to their group for discussion.

(See students' activity sheet after this lesson note)

STEP III: Activity 6.7

The mouth part of housefly

Activity sheets 6.8 were provided to students to carry out some exercises Their result were submitted to their groups for discussion

STEP IV: Discussion and writing final report session

The result of the activities conducted were discussed as follows:

Group discussion 5 minutes

Class discussion10 minutes

Writing individual final report 20 minutes.

EVALUATION: The teacher evaluated the lesson by asking the students the following questions.

1 Explain how grasshopper feeds

2 Describe the structure of the mouth part of grasshopper

3 How does housefly feeds?

4 Compare the structure of the mouth of housefly to that of grasshopper

CONCLUSION : The teacher concluded the lesson by briefly summarizing the lesson taught, such as methods of feeding in insects, the mouth parts of a grasshopper and its method of feeding. The structure of mouth of housefly and its method of feeding. The next lesson will be, how plants make their own food.

ACTIVITY 6.5 Time : 40 minutes

Methods of feeding in insects

Unlike the bigger animals, insects feed by biting and sucking.

Activity 6.6

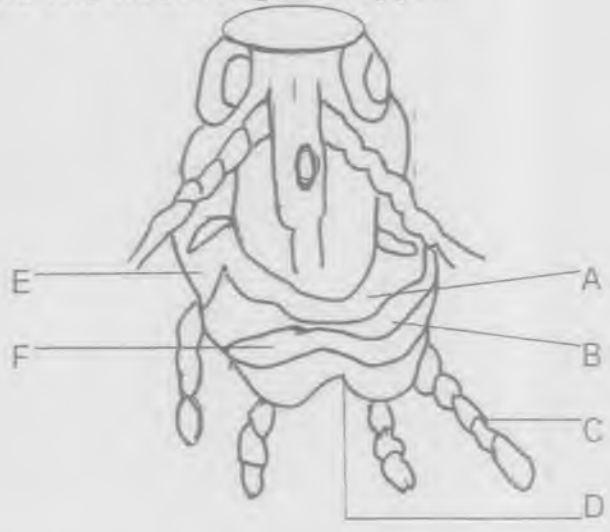
Give example of the sucking insects

(1) (2)

Give examples of two biting insects

(1) (2)

Activity 6.2 The mouth of grasshopper.



Observe the mouth-part of a grasshopper from the specimen given to you by the use of hand lens. Carefully label the following parts A,B,C,D,E,F above.

From the observation give the reason why grasshopper can feed by biting , list two insects that feed by biting method.

(1) (2)

Give an example of any damage that can be caused by grasshoppers in Nigeria

Activity 6.7

Method of feeding of the housefly

Housefly cannot feed on solid food. it always feeds on liquids. This type of feeding is called sucking or lapping.

Give 3 examples of sucking or lapping insects. Observe the specimen of a housefly given to you the aids of hand lens describe how the proboscis looks like. Explain how the proboscis is adapted for sucking.

Activity 6.8

Catch a housefly and keep it in a jar for a day without food. Cover the bottle with muslin or wire gauze so as to allow air to enter the jar. Then put a little sugar in the jar and watch the insect.

Report your observation briefly.

LESSON NOTE 5

Group: Experimental

Method of teaching: NISTEP mode of teaching.

Subject: Integrated Science

Lesson (5) Unit 3

Unit title: Feeding in plants and animals

Time. Double period (80 minutes)

No of pupils: 40 Class: JS III

Topic: How plants make their food.

Instructional materials: Students' activity sheets

BEHAVIOURAL OBJECTIVES: By the end of the lesson students were able to

1 Define photosynthesis

2. State at least 3 factors necessary for photosynthesis to take place.

3. Mention the importance of photosynthesis to life in general.

4. Conduct a simple experiment to detect the presence of starch in a plant.

PREVIOUS KNOWLEDGE: Students have learnt about how feeding takes place in Animals. E.g mammals, insects etc.

INTRODUCTION: The teacher introduced the lesson by asking the students the following questions:

a. Herbivores are animals that feed on what type of food substance. Examples of such animals are '----------

b Mention at least two types of insects and state the type of food they feed on.

The teacher told the students that the lesson for today is on how plants make their food.

PRESENTATION OF THE LESSON:

After grouping the students into 5 consisting of 8 students to carrying out the following activities.

Step I Activity 6.9

How plants make their food.

Students of each group were provided with activity sheet 6.8 to carry out the activities stated. The answers were provided by the students and submitted to various groups for discussion. (See students' activity sheets after this lesson note)

Step II: Activity 7.0

Testing plants storage organ for starch.

Activity sheet 7.0 was provided to the students. They were instructed to carry out the exercises and provide the answers. The answers were submitted to groups for discussion.

Step III: Discussion and writing final report lesson

The answers submitted from the various groups were discussed as follows.

Group discussions	5 minutes
Class discussion	10 minutes
Writing individual final report	20 minutes

EVALUATION: The teacher evaluated the lesson by asking the students the following questions:

(a). What is photosynthesis?

(b). Mention 3 factors necessary for photosynthesis to take place

(c) State the importance of photosynthesis to life

(d). How would you detect the presence of starch in a plant storage organ:

CONCLUSION: The teacher concluded the lesson by briefly summarizing the lesson such as; the process of photosynthesis and the experiment to test presence of starch in a plant storage organ.

Students' Activity sheet 7

Time: 30 minutes

How plants make their food

No animal can make its own food from simple materials occurring around it. For example man cannot make his food from air and water. Yet plants are able to do this very remarkable thing. They can make their own food from gases.

which occur in the air. The process where plants manufacture their food by the use of sunlight with presence of carbondioxide is called photosynthesis.

Exercise: Read the following description carefully. Complete the equation by filing in the spaces with the missing words or symbols.

We can describe what happens in the photosynthesis by using symbols to represent the compounds involved. The starting substances (reactants) are carbon dioxide (CO_2) and water (H_2O). The products are oxygen (O_2) and glucose ($C_6H_{12}O_6$). The catalyst is chlorophyll and energy is provided by sun. We can summarise the reaction as follows:

$$? + H_2O \xrightarrow[\text{Chlorophyl}]{?} C_6H_{12}O_6 +$$

Missing words or symbol = light, $6CO_2$, $6O_2$

The glucose produced in photosynthesis can be built up into starch, which is stored in the plant organisms etc.

Activity 7.1 Testing plants storage organ for starch.

In this activity you will need iodine solution and small piece of yam, cassava, potato and some beans.

Add few drops of iodine solution to small pieces of plant material and record your observation. Can you offer explanation for the result?

LESSON NOTE 6

Group: Experimental

Method of teaching: NISTEP mode of teaching

Subject: Integrated Science

Lesson 6 Unit 4

Unit title: Feeding in plants and animals

Time: Double period (80 minutes)

No. of pupils: 40 Class: JS III

Topic: Chlorophyll as a factor involved in photosynthesis

INSTRUCTIONAL MATERIALS: Iodine solution, Green leaf, Variegated leaf, White tile, Test tube, 90% ethanol and dropper. Students' activity sheets

BEHAVIOURAL OBJECTIVES: By the end of the lesson students were able to:

(a) List at least 3 conditions necessary for photosynthesis to take place.

(b) Conduct a simple experiment to test for the presence of chlorophyll in a leaf.

(c) List at least 5 materials used to detect the presence of chlorophyll in a leaf.

PREVIOUS KNOWLEDGE: Students have learnt about photosynthesis and how to test the presence of starch in plant organ Such as yam etc.

INTRODUCTION: The teacher introduced the lesson by asking the students the following questions:

(a) What is photosynthesis?

(b) Describe a simple experiment on now to detect the presence of starch in a plant storage organ.

The teacher explained to the students the lesson topic, which is chlorophyll as on of the factors, involved in photosynthesis.

PRESENTATION OF THE LESSON.

After dividing the students into 5 groups of 8 students each. The lesson was presented as follows:

Step I: Activity 8

Chlorophyll – As factor involved in photosynthesis

Students were provided with activity 8 work sheet. They were instructed to carry out activities stated on the sheet.

Step II: Discussion and writing final report session

The answers were submitted to their various groups and were discussed as follows:

Group discussion	5 minutes
Class discussion	10 minutes
Writing individual final report	20 minutes

EVALUATION: The teacher evaluated the lesson by asking the students the following questions:

(a) Mention at least 3 factors needed for photosynthesis to take place.

(b) Briefly explain how you will conduct a simple experiment to test for presence of chlorohypll.

(c) List at least 5 materials to be used in testing for the presence of chlorophyll in green leaf.

CONCLUSION: The lesson was concluded by briefly summarizing the lesson conducted such as, the factors involved in photosynthesis. The next lesson will be on testing leaf for starch.

Student Activity Sheet 10

Activity 10 Time: 40 minutes

Activity 10.1 Factors involved in photosynthesis- Chlorophyll

You need some variegated leaves (e.g from the cotton) and the material for testing starch (such as test tube, boiling water bath, 90% ethanol, dropper, a white tile, iodine solution, and green leaves.

Cut pieces from the different coloured part of the leaf.

Test the different coloured section of the leaf for starch.

Test for the presence of starch in the green leaf what do you observe?

How can you explain these observation?

What conclusion can you draw from the observation?

APPENDIX B

LESSON NOTES FOR THE CONTROL GROUP

LESSON NOTE ONE

Method of teaching Science = Lecture method

Subject: Integrated Science

Lesson I

Group: Control

Class: JS III

Unit Title: Energy conversions

Time: Double period (80 minutes)

Topic: Forms of energy

INSTRUCTIONAL MATERIALS: Candle, Battery, Flashlight bulb, A radio, Tape recorder, Electric motor, A match box, Torchlight.

BEHAVIOURAL OBJECTIVES: By the end of the lesson students were able to

(a) Define what energy is

(b) Give example of various forms of energy

(c) List the sources of energy mentioned in (b) above.

(d) Identify the importance of energy to their day-to-day activities.

PREVIOUS KNOWLEDGE: Students have learnt what energy is

INTRODUCTION: The teacher asked the students the following questions:

(a) Define the word energy

(b) Rub your palm together for a minute what happens?

PRESENTATION:

The teacher presented the lesson as follows:

Step I: The teacher explained that , energy is so important in every thing we do. A body that has energy can do work. For example the moving car uses energy, animal moving from one place to another uses energy, electric fan radio, television set, falling moving mango, all these require the use of energy before they can work. There are various forms of energy. We have chemical energy, kinetic energy, potential energy, electrical energy, light energy and sound energy. The primary source of this energy is from sunlight. For example, the energy transfers from sunlight to the plants through the process of photosynthesis and to animals through feeding from the plant. This form of energy can be converted in to one form to another.

Step II: The teacher explained to the students the examples of the energy stated above as follows:

Chemical energy: Example form fuel, e.g petroleum, kerosene, food, gas, battery etc.

Kinetic energy: Moving objects such as electric fan (also called mechanical) a moving car, an airplane, a moving animal etc.

Potential energy: The body at rest when it is set to carry out certain function e g a fruit that is to fall from a tree. Also an animal that is set to run or jump are said to have possessed potential energy.

Electrical energy: From electricity, battery. This is in form of currents.

Light energy: From burning of some fuels. E.g wood,petroleum, kerosene, candle etc.

Heat energy: From contact between two surfaces (e.g friction) and movement of body in an object.

Sound energy: From playing of musical instruments such as drun, guitar, piano, clapping of hands. Also from the voice box of animals. E.g man dog etc.

Step III: The teacher gave the students materials such as, candle, battery, fire wood, radio, telephone head, flash light bulb, electric fan, a match stick, a torch light, o group them according to the type of energy they produce. For example.

Material		**Type of energy**
Match stick	-	Chemical energy, heat, light etc.
Candle	-	Chemical, heat, light
Battery	-	Chemical (it can form other types depending on the instrument or operation used e.g. when we connect

wire and flash light bulb we have light energy and heat energy.

Telephone ear piece	-	Sound energy
Telephone mouth piece	-	Electrical energy
Torch light	-	Light and heat energy
Firewood	-	Chemical, heat, light
Radio	-	Sound, kinetic and light

STEP IV: The teacher asked the students to mention other sources of energy apart from those stated above and the types of energies they posses.

EVALUATION :- The teacher asked the students the following questions.

a What is energy?

b Give example of various forms of energy.

c List the sources of energy mention(b) above

d identify the importance of energy to our day – to day activities.

CONCLUSION:- The teacher concluded the lesson by explaining to the students briefly the today's lesson. That is, what they have learnt such as what energy is , the types of energy, their sources and their use in our day – to –day activities. The teacher told them that the next lesson will be on energy conversion or changing energy from one form to the other.

Assignment: The teacher told the students to read more about types of energy and their sources at home.

LESSON NOTE TWO

Method of teaching: Lecture

Subject: Integrated Science

Lesson 2 Unit 2

Group: Control

Class Js III No. In class = 40

Unit title = Energy conversion

Time = Double period (80minutes)

Topic = Changing energy from one form to another.

INSTRUCTIONAL MATERIAL: Dry cell battery, match stick, candle, Telephone machine, flexible wire, flashlight bulb, Radio, Tape recorder, electric fan, A stapling machine, A torchlight etc.

BEHAVIOURAL OBJECTIVES:- By the end of the lesson students were able to :

a Explain how energy can be transferred into one form to the other.

b Classify the sources of energy (based on the material provided) into the types of energy conversion they fall into.

c Give example of home applicants and trace their energy transformations that can take place.

d identify the importance of energy conversion to our day – to -day activities

PREVIOUS KNOWLEDGE: Students have learnt about types of energy and their sources. E. g chemical energy from the food we eat etc.

INTRODUCTION: The teacher asked the students the following questions.

1 Name at least 5 types of energy

2 Give an example of the sources of the energy mentioned in (10 above.

PRESENTATION

The teacher presented the lesson based on the followings steps.

STEP I: The teacher asked the students to mention various types of energy and an example of their sources as follows.

Types of Energy	Possible Sources
Chemical	Match stick, food,etc.
Electrical	Battery, electricity etc
Potential	Fruit, Animals And rest.
Kinetic	Fan, motor car etc
Light	Battery, fuel, electricity etc.
Sound	Radio, telephone, tape recorder
Heat	Fuel, battery, electricity etc.

STEP II: The teacher discussed the energy transformation as follows.

CHANGING POTENETIAL ENERGY TO KINETIC ENERGY

When an object rest at a point some height above the ground, we say that the object has **Potential Energy.** This is because the object is capable of doing work if free . Work must have been done on the objects in taking it to this position. This work done is stored in the object as potential energy. As the object is free if falls towards the ground because of the gravitational pull on it while falling.

At each point in its motions, it has both potential energy decreasing and the kinetic energy increasing. This means that the potential energy is being converted to kinetic energy during the motion downward. Just before it hits the ground, all its original potential energy is converted to kinetic energy.

Consider these questions (1) A mango falls from the branch to the ground. What energy had it when left the branch? What energy had it just before it hits the ground? What energy had become of this energy when it hits the ground? A gun is fired and the bullet from it hits a bird which falls to the ground. What energy changes took place from the moment of firing the gun to the moment of firing the gun to the moment the bird hits the ground?

If you have answered these questions correctly, you will find that in each example; you have started off with one form of energy and ended up with another forms.

STEP II The teacher explained the other types of energy conversion to the students as follows:-

Rub your palm together for about two minutes what do you notice? What happens was that your palm used kinetic energy and convert it to heat energy. Also when you put in an empty in and the tin is shaken it will produce sound. this is another conversion from kinetic energy to sound energy conversion from kinetic energy to sound energy. Another example of energy conversion is as follows.

A dry cell battery possesses chemical energy this chemical energy can be converted into electrical energy as the energy passes through flexible wire it is now been converted into light energy and heat energy when connected with flash light bulb. Also the dry call battery is connected through the flexible wire and the positive part and the negative part of the wire were connected with dry cell battery light and heat are produced. This is another example of energy transformation. The two example cam be summarized as;

The first one Chemical ⟶ Electrical ⟶ light & heat energy

The Second one Chemical ⟶ Electrical ⟶ light & heat energy

Heat energy to light can be replaced as follows: -

When we heat any solid and it becomes red hot, it glows. Fire wood and metals often glows when they are heated. This example of energy conversion from heat to light energy e.g. Heat energy ⟶ light energy.

STEP III: The teacher explained to the students that energy conversion can be done into so many steps from one form to another examples are as follows:

1. A stone can be strike on iron bar the product will be heat and light. The energy transformation is therefore as follows:

   Mechanical (Kinetic) ⟶ Sound ⟶ Heat ⟶ Light energy

2. Another example is that of electrical energy to mechanical and sound energy. This can be explain by the use of electric bell and telephone machine. This could be traced as follows:

Electrical energy (from electricity current)

Kinetic energy (from movement of striking bell) the sound (from the product of bell) ie

Electrical energy ⟶ Kinetic energy ⟶ Sound energy

Pressing Iron

An electric pressing iron converts electrical energy to heat, which is used to press clothes. It consists of coil of wire (filament), a plane metal surface, a switch and bimetallic strip. When current passes through the heating coil in the iron, electrical energy is converted into heat energy and the temperature of the iron rises when the iron reaches the temperature set by the switch, the bimetallic strip is bent and this switches off the current as the contact points are now

separated. When the pressing iron cools, the strip uncurls, contacts is again made current flow once and heat the filament.

The teacher asked the students to trace the energy conversion in another home appliances such as radio = Electrical ⟶ Kinetic ⟶ Sound energy

Radio (with battery) Chemical → Electrical kinetic → Sound and heat

Television = Electrical → light → sound → kinetic energy and heat energy

Electric fan = Electrical → sound → heat → kinetic

EVALUATION: The teacher asked the students the following questions:

a Explain the term energy conversions.

b Classify material provided into the types of energy they can produce

c Trace the energy conversion that take place in the following :

i Rubbing of finger on a berth

ii A moving vehicle (e.g. lorry)

iii Cooking of food (using firewood)

d Give 2 examples of home appliances that energy conversion takes place, and explain how that happens in each.

CONCLUSION: The lesson was concluded by the teacher by briefly summarizing what the children have learnt in this lesson such as (a) energy transformations.

a Examples of energy transformation

b application of energy transformation to our day -to -day activities.

c Students were assigned to read more about energy conversion in their NISP and other relevant text book.

ASSIGNMENT:

Students were asked to list more materials that can be used for this conversion of energy apart from three stated in this lesson.

LESSON NOTE 3 FOR CONTROL GROUP

Method of teaching: Lecture method.

Subject : Integrated science

Lesson 3: Unit 1

Group: Control

Class: Js III

No. in class = 40

Unit title : Feeding in Plants and Animals.

Topic : Method of feeding in Animals

Time: Double period (80 Minutes)

INSTRUCTIONAL MATERIALS :

1 Specimen of animals skulls, such as sheep, dog etc.

2 Also specimens of different types of teeth in incisors, canine, premolars and molars.

3 Pictures of some animals.

BEHAVIOURAL OBJECTIVES : By the end of the lesson students were able to .

a. Explain how bodies of plant and animals are adapted to feeding.

b. Explain the way plants make their food.

c. List different types of teeth with their functions.

d. Identify the importance of feeding to our day – to –day activities.

e. Draw and label types of teeth.

PREVIOUS KNOWLEDGE: Students have learnt what energy is and sources of the energy.

INTRODUCTION: The teacher introduced the lesson to the students as follows:-

You have learnt that feeding is one of the characteristics of living things.

You also learnt that living things (Plants and Animals) feed in order to get energy to carry out their daily activities and also grow. In this lesson you will learn about.

1 The adaptation of mouthpart of feeding.

2 The dentition of mammals.

3 Animals food and method of feeding.

PRESENTATION: The lesson was presented to the students by the teacher as follows :

STEP I : Adaptation of mouthpart for feeding.

The teacher explained to the students that parts of animals that are adapted to these types of feeding are as follows:

Certain parts of the bodies of animals are specially suited for feeding.

Consider your mouth and your jaws. In your mouth you have teeth.

Without them you would find it difficult to eat the kind of food you do such as meat and hard fruits.

All animals feeding on solid foods have teeth, with which they tear or grind their food before swallowing it. The number and arrangement of teeth is called dentition of the animal. the muscles of the jaw and check. the tongue and the lips

are also connected with feeding. The dentition of an animal is designed to suit the kind of food, which he animal eats. Animals can be divided into three groups according to the kind of food they eat these are the herbivores (or plants eaters), the carnivores (or flesh eaters), and the omnivores (which eat both flesh and plant). The teacher asked the students to write down the names of three animals in each group.

STEP II: Structure of the tooth.

The teacher explained to the students the structure of the tooth as follows:

The front teeth are **Incisors.** If you think of a line dividing the jaw into two parts, a right part and left part there are two incisors on each side of the line in the upper jaw and two on each side in lower jaw. in other words, you should have eight incisors altogether, four above and four below. See diagram 4.1 below

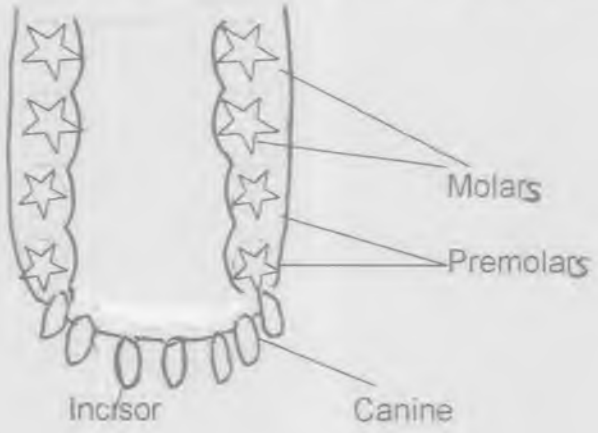


Fig 4.1. The lowered jaw dentition in mammals.

Next to the incisors come the canine teeth. Why are they called canine? (the teacher will expect the answer from the student before telling them the answers.

You have one canine tooth on each side in the top jaw and the same number below, giving you four canine altogether (see fig. 4.1 above) the Incisors and the canines are for biting and cutting.

Next to the canines comes the premolars. These look very different from the incisors or canines. They have broad surface and are much bigger than two of these on each side of the jaw, above and below, making eight altogether the further still you have the molars themselves. These are bigger still. The premolars and molars are used for chewing and crushing. It is the molar that often called a wisdom tooth possibly because if does not appear until you are old enough to have become wise! An adult should have three molars on each side, top and bottom of the jaw. How many teeth should an adult have altogether? To save a lot of writing when describing dentition of mammal, we represent the number of teeth that an animal has, and their types by what is called a dental formula. In this **I** stand for Incisors, **C** stands for canine, **P** stands for Premolars and **M** for Molars. The dental formula for an adult man is thus:

$$I\ \frac{2}{2} \qquad C\ \frac{1}{1} \qquad P\ \frac{2}{2} \qquad M\ \frac{3}{3}$$

As the right hand side should be the same as the left, we only write down the formula for one side. The top and bottom numbers show the number of teeth of the different types in the top and bottom jaws. From the formula, you can see that an adult man should have 8 teeth on top right jaw (2 + 1 + 2 + 3) and 8 on the

bottom right, and as the left hand side is just the same, he should have a total of 16 on the left – hand side. Given the total of 32 teeth.

STEP III: Animal foods and methods of feeding

The teacher explained the types of feeding method of some animals as follows:

A **CARNIVORES:** These categories of animals are flesh eaters. The family include, the cat, lions, leopard, dog etc. The cat has a dental formula of :

$$I\ \frac{3}{3} \qquad C\ \frac{1}{1} \qquad P\ \frac{3}{2} \qquad M\ \frac{1}{1}$$

Note how they differ from yours.

The incisors are small and chisel – shaped. The canines are enlarge into fangs, and the cheek teeth (premolar and molars) have their crown extended into ridges running along the line of the jaw. The ridges are sharp and are used like a pair of scissors.

The cat kills its prey with its sharp canines, cuts the flesh into pieces with scissors like motion of its jaw and swallows it. Carnivores generally feed by tearing their food; this is the way a dog feeds. Does it chew its food before swallowing it?

STEP IV: Other types of feeding method were explained to the students as follows:

HERBIVORES :

These are types of animal that feed on plants materials such as vegetable and many grass. They do not feed on flesh at all. example are sheep, cow, goat etc In this lesson, we shall take a cow as an example which has this dental formula.

$$I\ \frac{0}{0} \qquad C\ \frac{0}{1} \qquad P\ \frac{3}{3} \qquad M\ \frac{3}{3}$$

The cow has more teeth in its lower jaw. There are no incisors in the lower jaw these types of dentition is adapted for grass eating the premolars and molars are well adapted for grading the grasses.

OMINIVORES :

These are groups of animals that feed on both plant and animal products. You already know what dental formula is and have seen that it is well design to enable you to feed on variety of foods. You can bite and chew bones or hard foods can be broken with the strong incisors. Grinding of food into fine particles is made very easy with the help of the molars and the side movement of the jaw. Example of animals that feed with this method is man, monkey, pig etc. Unlike the cow and sheep, human beings have the same number of teeth in the upper and lower jaws.

EVALUATION:

The teacher asked the students the following questions:

1 Explain how the teeth of animals are adopted to their method of feeding.

2 List three method of feeding with example of two animals in each group.

3 List different type of teeth as follows :

(i) Name (ii) shape and (iii) function

4 Give an example of dental formula and the type of feeding habit adopted for such types of feeding.

5 Draw and label the structure of lower jaw and the structure of the teeth involved.

6 Identify the importance of feeding in animals.

CONCLUSION:

The lesson was concluded as follows. In this lesson you have learnt about, the adaptation of mouth parts for feeding and different method of feeding in animals such as carnivores e.g cat, herbivores e.g cow. You have seen different types of teeth with their function and formula. In the next lesson we shall study the feeding method in insects, so read this in your note before the lesson.

ASSIGNMENT;

The teacher asked the students to list three types of feeding method learnt and give example of animals in each group apart from those stated in this lesson.

LESSON NOTE 4: CONTROL GROUP

Method Of Teaching: Lecture

Subject Integrated Science

Lesson 4 unit 2

Group control

Class Js 111

No in class = 40 pupils.

Time: Double period (80 minutes)

Topic: Method of feeding of insects

INSTRUCTIONAL MATERIALS: A grasshopper or cockroach, A housefly, Hand lens,Glass jar, Sugar etc.

BEHAVIOURAL OBJECTIVES: By the end of the lesson students were able to:

a Explain method of insects such as housefly, grasshopper, caterpillar.

b Classify different type of insects based on their mode of feeding.

c Draw and label the structure of an insect mouth part e.g. grasshopper.

d Identify the importance of structure of insect mouth parts to their feeding habits and how it affects man in his environment

PREVIOUS KNOWLEDGE: Students have learnt about feeding method in mammals e.g. cow, man, cat etc.

INTRODUCTION: The teacher asked the students the following questions

a. List the three types of feeding in mammal.

b Mention types of teeth you know i.e incisors, canine, premolars and molars.

PRESENTATION:

The lesson was presented by the teacher as follows:

STEP I: Feeding method in Insects.

The teacher started the teaching by explaining the feeing methods in insects as follows:-

Unlike bigger animals, insects feed by biting and sucking.

Biting (or chewing) insects include the grasshopper, the locust and the caterpillar (the lower stage of the moth or butterfly) amongst, of course many others. These are insect, which you will easily find on a farm or in your garden. You can watch a grasshopper feeding if you approach it very quietly. The mouth parts of a grasshopper are so constructed to help it feed by biting leaf blade.

There are large number of different types of insects that feed by sucking or "lapping". Some of them are beneficial to mankind, others are harmful mosquitoes feed by sucking of blood. It has been known for long time that certain kinds of mosquitoes transmit malaria germs for example anopheles mosquitoes, other common sucking or lapping insect are housefly, bees, wasps, and butterflies.

For example, Housefly is harmful because it is so easily carries disease germs from one place to another for example, dysentery is one of such disease.

STEP II: Method of feeding of housefly

A housefly cannot feed on solid food it always feeds on liquids. So it has to convert solid food to liquid before it can use it. When settles on food, it extend its mouth part (called the proboscis) on to the food. It sends salivary gland down the proboscis and to the food, and the saliva immediately started to digest the food and turn it into a liquid. The liquid food in them sucked up by the proboscis into the esophagus and then into the stomach.

STEP III: Method of Feeding of a Grasshopper

Grasshopper uses the part of its mouth such as labium, maxilla, mandible, and labrum for cutting and chewing process. The cutting process is similar to that of a pair of scissors, that's why it can feed on solid soft substances like leaves etc.

Grasshopper can cause consideration loss to the farmer. A locust will eat its own weight of vegetable in a day, and when you remember that a swarm of locust may well number over thousands million, you can imagine what a tremendous amount of harm they do. Infact famines have been cause by them.

Observe the mouth part of grasshopper and draw and label in your note book.

EVALUATION: The teacher asked the students the following questions:

a List two examples of mode of feeding in insect with two example of the types of insect involved

b Describe the feeding habit of a housefly

c Draw and label the structure of grasshopper's mouth part.

d Explain how the mouth parts are associated with their types of feeding

e Mention one way in which insects use their mouth parts in transmitting some common diseases.

CONCLUSION: The teacher concluded the lesson by given brief explanation of this lesson as follows. Today you (student) have learnt about types of feeding in insects. In the next lesson we shall be discussing how plants make their foods.

Assignment: The teacher gave the students the assignment as follows :

List as many insects you know as possible and classify them under their mode of feeding.

LESSON NOTE 5 FOR CONTROL GROUPS

Method of teaching: Lecture method.

Subject : Integrated science

Lesson 5 unit 8

Group control

Class Js III

No. in class = 40

Unit title : Feeding in plants and animals.

Time Double period (80 Minutes)

Topic : Method of feeding in plants.

INSTRUCTIONAL MATERIALS : Potted plant, Green leaves, Variegated leaves, Roots, Iodine solution etc.

BEHAVIOURAL OBJECTIVES : By the end of the lesson students were able to

a Explain the process of how green plant make their food.

b Distinguished between green plants and variegated plant leaves.

c Describing a simple experiment to test the type of food stored in plants.

d Identify the parts of the plant involved in food making.

e Identify the importance of plants food to our daily activities.

f Mention various parts of the plants that can store food.

PREVIOUS KNOWLEDGE: Students have learnt the mode of feeding in animals, e.g. mammals : carnivore, herbivore and omnivore and insect such as sucking and chewing.

INTRODUCTION: The teacher introduced the lesson by asking students the following questions:

a. Can animal make its food from simple materials like air and water around it ?

Yet plants are able to do this, they can make their foods form gases, which occur in the air we shall see how this could be done in this lesson.

PRESENTATION:

The teacher presented the lesson before the student as follow:

Step I: How plants make their food.

The teacher explained how plant make their own food as follows:

The process by which the plant makes starch is called **photosynthesis.** This simply means building up by means of light. The word synthesis means building up. Photosynthesis is the most important chemical reaction in the world. If it did not take place you would not be here to read and remember your lesson on food chain in the previous lesson. Photosynthesis is the process by which green plants build up carbohydrates from carbon dioxide and water. The energy for the

synthesis is obtained from sunlight which is absorbed by chlorophyll. Oxygen in given off as a by – product. In land plants the water is absorbed from the soil by the root system and the carbon dioxide from the air through the stomata. Photosynthesis goes on principally in the leaves though any green part of plant can photosynthesized. The process may be represented by the equation

$$6CO_2 + 6H_2O + \underset{\text{Absorbed by chlorophyll}}{\underline{\text{Sunlight}}} = C_6H_{12}O_6 + 6O_2$$

Step II: The teacher explained to the students how carbon dioxide is presented in the leaf. When you burn a dried leaf in air it gives up carbon dioxide, when the gas give off is tested with lime it turns milky this indicated the presence of carbon dioxide in the leaves. The carbon dioxide is formed when plant is burnt indicates that there must be carbon in it. The gas that contains carbon is carbon dioxide, it must be the source of food material for plant. Carbon dioxide must be concerned with the making of starch in the green plant leaves. This can be conducted by simple experiment as follows:

Select sunlight plant or balsam plant and on one of the leaves clip a piece of black paper so that light cannot penetrate to the whole leaf. Let the plant stand for a day before testing for starch. Then take the leaf you have partly covered up, put it in boiling water and extract the chlorophyll with alcohol. Test the leaf for

starch by adding iodine. The part of leaf containing starch will turn brown from the yellowish colour. This indicates the presence of starch.

Step III: The teacher explained the parts of the plants concerned with making food. Obviously, the leaves have a lot to do with carbon dioxide, which enters leaves through stomata, and it diffuses through the leaf. Part of the food material for the plant is supplied by soil. But, of course a plant cannot take up solid dissolve in water these are taken up by the plant through the roots. These materials are salts of calcium, potassium, nitrogen, magnesium, phosphorus and some other elements. They dissolve in rainwater falling on the solid and are taken into plants through roots hairs. These are fine hairs, which out from the main root.

There are no holes in the root hair, so how does the solution of salts from the soil get in? This is very important process for both plants and animals. The root hair act like "molecules sieve" letting very tiny particles the size of molecules to pass through it , carbon dioxide and water from the soil meet in the leaf and are formed into starch. For the process to take place, there must be light energy.

Step IV: Food storage in plants.

The teacher explained the above topic as follows: We have discuss a very a simplified account of what happen when plant makes starch. Sugar is formed first in the leaf of the plant and the starch is made from sugar. Sugar and starch are very similar chemical compounds. They belong both to group of substance called

element such as Carbon, Hydrogen and oxygen. Can you name a plant, which makes a lot of sugar and does not convert it into starch?

Some plants stored starch (e.g. yam, cassava, etc.) some, plants protein as well as some starch. Protein is nitrogen containing substance and it is essential for life. Plants obtain nitrogen from the soil to produce nitrogen. The supply of nitrate is not always sufficient and the farmers have often to add it to the soils in the form of fertilizers. Some store oil as in groundnut etc. plant store their food in special places called storage organ. Any part of the plant can be adopted for this purpose in the leaf, the root, the stem, and the seeds.

EVALUATION : The teacher evaluated the lesson as follows students were asked the following questions:

a. Explain the process by which green plant make up their food.

b. List the important thing necessary for photosynthesis.

c. How can you distinguish green leaf from variegated leaf?

d. Describe a simple experiment to test for starch in leaves.

e. Identify why food production is necessary for our daily activities.

f. Identify the part which food may be stored in plants.

CONCLUSION: The teacher concluded the lesson by briefly reviewing the topic of the lesson as follows students to day in this lesson you have learnt how plant manufactured their food, also how

to test for starch and, the necessary condition needed for photosynthesis to take place and the storage organ for food in plant. You are advice to read more about this in your various textbooks.

Assignment : Students were given the following assignments by the teacher

1. Observe different foods items at home and classify them into their various classes
2. Find out at least two reasons why food is important to our daily activities.

APPENDIX C

TEST OF INTEGRATED SCIENCE PRACTICAL SKILLS (TOISPS)

This instrument is meant to measure the performance of junior secondary classes III students in practical skills in integrated science. This is not in any way part of your continuous assessment your responses will be helpful in teaching and learning of science.

SECTION A ; PERSONAL DATA

Number _____

School _____

Gender Male ☐ Female ☐

SECTION B Answer all questions on the question paper provided.

INSTRUCTION ONE:

You are provided with following materials

(i) Dry cell batteries 1.5V

(ii) Flexible wires

(iii) Flash – light bulb

Connect the wire provided with a battery and the flash – light bulb to form a simple electric circuit.

Q1 i. What is the effect of the batteries on the bulb ?

_____

Q2 ii. Touch the bulb after some minutes what do you notice?

_____

INSTRUCTION TWO:

You are provided with (i) Dry cell batteries and (ii) radio sets.

Put the batteries in the radio set, put the radio on, record what you notice as follows:

Q3 i. What happens when the radio is put on?

_____

Q4 ii. Touch the speaker side of the radio what do you noticed ?

_____

Q5 iii. What happen to the light indicator of the radio?

_____

Q6 iv. Touch the bottom of the radio set, what do you noticed?

_____

Q7 v. What conclusion can you draw from this experiment about energy conversion? _____

INSTRUCTION THREE

Put some nails provided in an empty tin, cover the tin and shake it very well.

Record your observation as follows:

Q8 i. what do you noticed?

Q9 ii. Touch the bottom of the tin what do you noticed?

Q10 iii. What conclusion can you draw from this experiment about energy conversion? _____

INSTRUCTION FOUR:

You are provided with a glass mirror, use it to observe the structure of different types in your mouth, based on your observation record your results by answering the following questions:

Q11 i. How many teeth have you noticed?

Q12 ii. Name the types of teeth noticed?

Q13 iii. Describe each of the type of teeth observed

Q14 iv. What conclusion can you draw from the observation s it relates to the function of each tooth?

INSTRUCTION FIVE:

The following structures are provided to you upper jaw and lower jawbone of a sheep consisting some teeth observe the structures and record your observation as follows:

Q15 i. How many types of teeth have you noticed? _____

Compare the arrangement of the teeth provided with that of man. What do you noticed?

State two differences in their arrangements.

Q16 i. _____ (ii) _____

Q17 ii. Look at the structure and arrangement of both your teeth and that of sheep. Represent the arrangement by using dental formulae.

INSTRUCTION SIX:

A housefly is kept in a jar for a day without food. Put a little sugar in the jar.

Q18 i. What do you observe? _____

Q19 ii How does this insect feed based on your observation?

_____

iii. Take the housefly pin it on a paper use a hand lens to observe the structure of the mouth.

Q20 How does the mouth look like? _____

Q21 iv what conclusion can you draw from you observation in relation to feeding habit of a housefly? _____

INSTRUCTION SEVEN:

The following materials are provided pieces of yam, cassava, beans, groundnut, and iodine solution. Use a piece of stick or a glass rod to put a small quantity of iodine solution on the food items. Record your result as follows:

	Food items	Type of colour noticed
Q22	Yam + Iodine solution	
Q23	Groundnut + Iodine solution	
Q24	Cassava + Iodine solution	
Q25	Beans + Iodine solution	

Q26 What conclusion can you draw from the above experiment?

INSTRUCTION EIGHT :

Two types of leaves are placed before you A & B labeled specimen A & B observe the two different leaves and name the two leaves as

Q27 Specimen (a) is _____

Q28 Specimen (b) is _____

Q29 State one major difference you notice from the two leaves base on their colours _____

Q30 What conclusion can you draw from this observation?

TEST OF INTEGRATED SCIENCE PRACTICAL SKILLS (TOISPS)

MARKING SCHEME.

Q1 I Light was produced (1 mark).

Q2 ii. There was heat (1 mark).

Q3 iii chemical energy was converted into light and heat energy (2marks). = (4 marks).

Q4 i. There was sound (1 mark).

Q5 ii. Movement (kinetic) (1 mark).

Q6 iii. Light was produced. (1 mark).

Q7 iv. It was warmed (heat) (1 mark).

Conclusion - chemical energy (1 mark).

Q8 Energy was converted into sound, movement, light and heat energy in the radio set. = (4 marks).

1 + 1 + 1 + 1 = 4

= (9 marks)

Q9 i. Sound was produce (1 mark).

ii. It was warm (heat was produced) (1 mark).

Q10 Kinetic (movement) energy can be converted into sound and heat energy. (2 marks).

Total = (4marks)

Q11 i. 32 (1 mark).

Q12 ii. Incisors, Canine, Premolars and Molars (4 marks)

Q13 iii. a. Incisors - Flat shape (1 mark).

b Canine - sharp pointed (1 mark)

c Premolars - Blunt and wide (1 mark).

d Molars - Blunt and wide(1 mark). = (9marks)

Q14 Incisors is used for cutting (1 mark).

Canine is used for tearing (1 mark).

Premolar is used for grinding (1 mark).

Molar is used for grinding (1 mark).

= (4 marks)

Total (13 marks)

Q15 i. Two types of teeth at the upper jaw (i.e 3 premolars and 3 molars) (3 marks)

Q16 There are gaps before the premolars at the upper jaw (1 mark). No incisors and canine at the upper jaw in sheep (1 marks)

ii. At the lower jaw there are 3 incisors and 1 canine, premolars are 3 and molars too are 3, the same with that of man at both the upper and lower jaws. (5 marks) dental formula for an adult man thus.

Q17

Human being dental formula	sheep dental formula
$\frac{2}{2}\ I\ \frac{1}{1}\ C\ \frac{2}{2}\ P\ \frac{3}{3}\ M$	$\frac{0}{0}\ I\ \frac{0}{1}\ C\ \frac{3}{3}\ P\ \frac{3}{3}\ M$
I Mark	1 Mark

Total 6 marks

Q18 i. It is licking the sugar (1 mark)

Q19 ii. By sucking and lapping (1 mark)

Q20 iii. It is tube like (proboscis) (1 mark)

Total = (3 marks)

Q21 iv. Housefly mouth is adapted for sucking and lapping type of feeding type of feeding (1 mark).

Total (4 marls)

INSTRUCTION SEVEN

The following material is provided Pieces of yam, cassava, beans, groundnut and iodine solution. Use a piece of stick or a glass rod to put a small quantity of iodine solution on the food items. Record your result as follows:

	Food items	Colour observed
Q22	Yam + Iodine solution	Blue – black (1 mark)
Q23	Groundnut + Iodine solution	Yellowish (1 mark)
Q24	Cassava + Iodine solution	Blue – black (1 mark)
Q25	Beans + Iodine solution	Yellowish (4 marks)

Total = 4 marks

Q26 i. Specimen (A) is green leaf (1 mark)

Q27 ii. Specimen (B) is variegated leaf (1 mark)

Q28 ii. The green leaf (Specimen A) is completely green while specimen (b) variegated leaf has different colours such as red, brown, dark – brown.

Q29 iii Dark green. (1 mark)

Q30 The green leaves are suitable for photosynthesis while the variegated leaves are not. (1 mark)

Total = 4 marks

Grand Total = 48/2.4 = 20.

FACILITY AND DISCRIMINATION INDICES (f) AND (d) FOR TEST OF INTEGRATED SCIENCE OF PRACTICAL SKILLS (TOISPS).

Item No.	Key	R_U	R_L	$P = \frac{R}{T}$	$D = \frac{R_U - R_L}{\frac{1}{2}N}$
1	B	25	10	0.67	0.58
2	D	18	16	0.58	0.33
3	A	22	13	0.32	0.46
4	B	15	7	0.67	0.71
5	A	24	9	0.42	0.40
6	C	17	5	0.53	0.58
7	D	23	11	0.33	0.75
8	C	19	12	0.71	0.42
9	B	12	8	0.66	0.38
10	B	15	13	0.52	0.45
11	A	19	9	0.44	0.31
12	B	18	3	0.44	0.52
13	C	15	4	0.40	0.35
14	D	21	8	0.60	0.42
15	C	23	6	0.62	0.54
16	C	15	9	0.42	0.31
17	D	24	9	0.67	0.54
18	A	15	11	0.42	0.46
19	A	24	13	0.72	0.42
20	B	15	10	0.40	0.35
21	C	20	10	0.62	0.38
22	C	20	10	0.62	0.38
23	D	18	10	0.46	0.46
24	D	24	11	0.67	0.50
25	B	10	9	0.30	0.39
26	A	12	5	0.31	0.32
27	A	19	16	0.68	0.42
28	C	25	7	0.71	0.35
29	B	24	9	0.49	0.30
30	D	20	11	0.39	0.46
				Mean = 0.53	Mean = 0.44

APPENDIX D

INTEGRATED SCIENCE ACHIEVEMENT TEST (ISAT).

This instrument is meant to measure the academic achievement of junior secondary classes III students in integrated science. This is not in any way part of your continuous assessment. Your responses will be helpful in teaching and learning of science.

SECTION A ; PERSONAL DATA

Number _____

Gender Male ☐ Female ☐

SECTION B Answer all questions on the answer sheet provided shading the most appropriate answer on the alternative given.

Q1. In man the total number of incisors teeth are

a. 2 c. 6

b. 4 d. 8

Q2. In what way do you consider plants useful to man?

a. They provide carbohydrate needed by man.

b. Animal which is food for man feed on plants.

c. Plants produce fruits needed by man.

d. All of A,B,C are useful to man.

Q3. During the process of photosynthesis which of the following gases is produced?

a. Carbon dioxide

b. Oxygen

c. Hydrogen

d. Carbon monoxide

Q4. A plotted plant was kept in dark cupboard for 48 hours, a leaf from this plant was plucked and tested for starch and starch was found to be absent. One conclude that

a. The starch originally present in the leaf was used up while in the cupboard.

b. The leaf was dead while in darkness

c. Sufficient starch has not been formed

d. The starch in the leaf become too concentrated to react with iodine.

Q5. In the day time, plants need which of the following for photosynthesis?

a. Carbon dioxide

b. Oxygen

c. Hydrogen

d. Nitrogen

Q6. Which of this statement is true about energy?

a. Energy is transmitted only by energies

b. Energy can be changed from one form to another

c. Heat is not a form of energy

d. Human being do not need energy

Q7. Which of the following actions/operations will not result in heat energy?

a. Striking a match stick

b. Rubbing your hands

c. Pressing a spring down on the desk and let it go

d. Connecting a bulb to a battery with a piece of wire

Q8. The form of energy that food has is :

a. Heat energy

b. Kinetic energy

c. Sound energy

d. Chemical energy

Q9. A simple cell converts chemical energy to

a. Heat energy

b. Kinetic energy

c. Sound energy

d. Electrical energy

Q10. In human bring the total number of Canine teeth is:

a. 2

b. 4

c. 6

d. 8

Q11 The main part of plant responsible for photosynthesis is:

a. Root

b. Stem

c. Leaf

d. Seed

Q12. Which of this energy conversation takes place during telephone conversation?

a. Electrical → Sound → Electrical

b. Sound → Electrical → Sound

c. Chemical → Magnetic → Sound

d Sound → Magnetic → Sound

Q13. What energy changes take place when battery lights up the bulb?

a. Electrical → Light → Chemical

b. Light → Electrical → Potential

c. Heat → Movement → Heat and Light

d. Chemical → Electrical → Heat and Light

Q14 Which of the following is NOT a sucking insect?

a. Bees

b. Praying mantis

c. Housefly

d. Butterfly

Q15. Which of these is not a function of photosynthesis? The

a. Removal of carbon dioxide from the atmosphere

b. Addition of oxygen to the atmosphere

c. Manufacture of starch

d. Oxidation of glucose to release energy.

Q16. The teeth labeled X in fig. 3 is

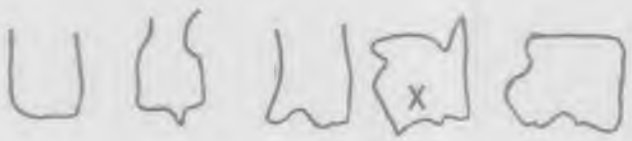


Fig. 3

a. A molar c. A premolar

b. A canine d. An incisor

Q17. The teeth labeled X is use for

a Cutting c. Tearing

b. Gnawing d. Grinding

Q18



Fig. 5

The Skull in fig. 5 could have been that of

a. Dog

b. Sheep

c. Cat

d. Man

Q19. Which of the following insect feed by cutting?

a. Mosquito

b. Wasp

c. Bee

d. Grasshopper

Q20. The following food items can be tested for the presence of starch by the use of iodine solution EXCEPT

a. Cassava

b. Yam

c. Beans

d. Potato

INTEGRATED SCIENCE ACHIEVEMENT TEST (ISAT)

Marking Scheme

Answers

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

20. C

Each correct answer carries 1 mark (One) each

1 x 20 = 20/20 Total = 20 marks

APPENDIX E

SUMMARY OF CORRELATION COEFFICIENT BETWEEN PRACTICAL ACTIVITY PERFORMANCE AND ACADEMIC ACHIEVEMENT OF STUDENTS IN INTEGRATED SCIENCE.

Variables	VI (Practical Pre test)	V2 (Practical Post test)	V3 (Academic Pre test)	V4 (Academic Post test)
VI (Practical Pre test)	1.000 (N = 50) P =	.2652 (N = 50) P = .093	.0371 (N = 50) P = .798	.1345 (N = 50) P = .000
V2 (Practical Post test)	.2652 (N = 50) P = .0631	1.000 (N = 50) P =	-.2404 (N = 50) P = .093	.7523 * (N = 50) P = .000
V3 (Academic Pre test)	.371 (N = 50) P = .063	.2404 (N = 50) P = .093	1.000 (N = 50) P =	.0288 (N = 50) P = .843
V4 (Academic Post test)	.1348 (N = 50) P = .351	.7523 * (N = 50) P = .000	.0288 (N = 50) P = .843	1.000 (N = 50) P =

* Significant at $P \leq 0.05$.

RELATIONSHIP BETWEEN PRACTICAL ACTIVITY PERFORMANCE AND ACADEMIC ACHIEVEMENT OF FEMALE STUDENTS

Variables	VI (Practical Pre test)	V2 (Practical Post test)	V3 (Academic Pre test)	V4 (Academic Post test)
VI (Practical Pre test)	1.000 (N = 25) P =	-.3633 (N = 25) P = .074	-.3311 (N = 25) P = .106	.0174 (N = 25) P = .934
V2 (Practical Post test)	-.3633 (N = 25) P = .74	1.000 (N = 25) P =	-.5135 (N = 25) P = .009	.7628 * (N = 25) P = .000
V3 (Academic Pre test)	- 3311 (N = 25) P = .106	.5135 (N = 25) P = .009	1.000 (N = 25) P =	-.2312 (N = 25) P = .843
V4 (Academic Post test)	.0173 (N = 25) P = .934	.7628 * (N = 25) P = .000	-.2312 (N = 25) P = .266	1.000 (N = 25) P =

* Significant at $P \leq 0.05$.

RELATIONSHIP BETWEEN PRACTICAL ACTIVITY

PERFORMANCE AND ACADEMIC ACHIEVEMENT OF FEMALE STUDENTS

Variables	VI (Practical Pre test)	V2 (Practical Post test)	V3 (Academic Pre test)	V4 (Academic Post test)
VI (Practical Pre test)	1.000 (N = 25) P =	.1748 (N = 25) P = .403	.2650 (N = 25) P = .200	.2441 (N = 25) P = .240
V2 (Practical Post test)	.1748 (N = 25) P = .403	1.000 (N = 25) P =	.1328 (N = 25) P = .527	.6221 * (N = 25) P = .000
V3 (Academic Pre test)	.2650 (N = 25) P = .200	.1328 (N = 25) P = .527	1.000 (N = 25) P =	.0446 (N = 25) P = .832
V4 (Academic Post test)	.2441 (N = 25) P = .240	.6221 * (N = 25) P =.000	.0446 (N = 25) P = .832	1.000 (N = 25) P =

* Significant at $P \leq 0.05$.

APPENDIX F

NIGERIAN INTEGRATED SCIENCE ACHIEVEMENT TEST

STUDENTS' ANSWER SHEET

Instruction : Shade the most appropriate answer in the column provided

	A	B	C	D
1.	[ ]	[ ]	[ ]	[ ]
2.	[ ]	[ ]	[ ]	[ ]
3.	[ ]	[ ]	[ ]	[ ]
4	[ ]	[ ]	[ ]	[ ]
5	[ ]	[ ]	[ ]	[ ]
6	[ ]	[ ]	[ ]	[ ]
7	[ ]	[ ]	[ ]	[ ]
8	[ ]	[ ]	[ ]	[ ]
9	[ ]	[ ]	[ ]	[ ]
10	[ ]	[ ]	[ ]	[ ]
11	[ ]	[ ]	[ ]	[ ]
12	[ ]	[ ]	[ ]	[ ]
13	[ ]	[ ]	[ ]	[ ]
14	[ ]	[ ]	[ ]	[ ]
15	[ ]	[ ]	[ ]	[ ]
16	[ ]	[ ]	[ ]	[ ]
17	[ ]	[ ]	[ ]	[ ]

18	[ ]	[ ]	[ ]	[ ]
19	[ ]	[ ]	[ ]	[ ]
20	[ ]	[ ]	[ ]	[ ]

APPENDIX G

FACULTY OF EDUCATION

AHMADU BELLO UNIVERSITY

ZARIA

Our Ref DE/S.25 Date: 17/3/99

The Principal,
Therbow secondary School.
Sabon – Gari,
Zaria.

Dear Sir,

STUDENT'S FIELD RESEARCH

The Department of Education, Ahmadu Bello University, Zaria, requires each students working for a degree to complete a research project. Our students entering the final year of their studies will be collecting data during the year.

This candidates will need to be allowed access to certain relevant documents and some valuable information which you have, or may need to use some periods in your school timetable as well your students. Please give assistance as much as possible. The bearer, Mal. Usman Isa Alhaji is our Ph.d student. The title of his research project is stated below:

TOPIC OF REASERCH

" THE RELATIONSHIP BETWEEN STUDENTS' PERFORMANCE IN PRACTICAL ACTIVITIES AND THEIR ACADEMIC ACHIEVEMENT IN INTEGRATED SCIENCE USING NISTEP MODE OF TEACHING"

Thank you for your continuing cooperation.

Yours Sincerely,

RESEARCH SUPERVISOR

(Dr. A.A.M. Shaibu)

APPENDIX G

FACULTY OF EDUCATION

AHMADU BELLO UNIVERSITY

ZARIA

Our Ref DE/S.25 Date: 17/3/99

The Principal,
Demonstration Secondary School.
A.B.U.
Zaria.

Dear Sir,

STUDENT'S FIELD RESEARCH

The Department of Education, Ahmadu Bello University, Zaria, requires each students working for a degree to complete a research project. Our students entering the final year of their studies will be collecting data during the year.

This candidates will need to be allowed access to certain relevant documents and some valuable information which you have, or may need to use some periods in your school timetable as well your students. Please give assistance as much as possible. The bearer, Mal. Usman Isa Alhaji is our Ph.d student. The title of his research project is stated below:

TOPIC OF REASERCH

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Thank you for your continuing cooperation

Yours Sincerely,

RESEARCH SUPERVISOR

(Dr. A.A.M. Shaibu)

APPENDIX H

Analysis of Test integrated Science Practical Skills (TOISPS)

Skills	Item Number
1. OBSERVATION List or description of observable characteristics of object, substance or phenomenon.	2,3,4,5,6,7,8,9,10,11,12, 15,17,22,23,24,25,29
2. **CLASSIFICATION** Use observable characteristics to sort things into groups.	11,12,15,17,27,28
3. **EXPERIMENTING** Choose an observable apparatus correctly for experiment and follow instruction to set up apparatus or complete a task.	1,2,8,11,22,23,24, 25,27,28,29
4. **DATA INTEPRETATION** Interpret observation in terms of a generalized statement.	1,7,10,13,14,18,19 20,21,26,30
5. RECORDING Recognise/use scientific conventions to represent information.	12,16,15

APPENDIX I

PILOT STUDY OF THE TEST ITEM.

A pilot test was carried out this study in order to ascertain the reliability of Test of Integrated Science Practical Skills (TOISPS) used for this study. Reliability of the instrument as well as item characteristics were determined. Also a pre – test was administered to the study subject to determine the equivalent or other wise of the experimental and control groups' performance.

SAMPLING OF STUDENTS FOR TEST ITEM CHARACTERISTICS.

Samples of two secondary schools in Zaria metropolis were selected. These schools were Alhuda – huda college Zaria and Government commercial college Zaria. Thirty students were selected from each of the schools. The total number of subjects used was sixty. The schools selected were within the target population of this study, but were not used for the final testing.

SAMPLING OF PRE-TEST STUDY SUBJECTS.

Two secondary schools from Zaria metropolis were selected for the pre-test administration. The schools were Therbow secondary school as the experimental group and Demonstration secondary school as the control group. Fifty students were randomly selected from each of the schools. The total number of pupils used is one hundred comprising of 50 males and 50 female students. The students used for the pre-test are the same used for post-test. the distribution of pupils for pre-test is presented in table 4.7 below.

Table 4.7

Distribution of pupils for pre-test Administration

S/No.	Name of school	Male	Female	Total	Group
1	Therbow School	25	25	50	Experiment
2	Demonstration School	25	25	50	Control
Total		50	50	100	

ADMISTRATION OF TESTS FOR ITEM CHARACTERISTICS

Test of Integrated Science Practical Skills (TOISPS) was administer to the pilot study group on two occasions with a period interval of two weeks as suggested by Tuckman (1975), this was because test-retest reliability coefficient was employed. The test were administered by the researcher. The instructions on the instrument were explained to the study subjects. The instruction for the tests was stated in Appendix C. No time limit was given for the tests , pupils were allowed enough time to complete the items on the tests on the two occasions. This was to enable a proper assessment of their performance to be made. Most of the students finished the tests within 60 minutes. The observed time was used in determining the duration for the pre-test and post administration. The item characteristic of Test of Integrated Science Practical Skills (TOISPS) were also determined. These are facility indices, discrimination indices and reliability coefficient.

ADMINSTRATION OF PRE-TEST.

Integrated Science Achievement Test (ISAT) and Test of Integrated Science Practical Skills Test (TOIPS) were administered to the experimental and control groups of this study. The test of practical skills consist of 30 test items while integrated science achievement test consists of 20 test items adopted from Inyang (1988) the timing of the tests were the same with that of pilot study test. Test of Integrated Sciences Practical skill timing was adopted from that of pilot study testing. While the of Academic achievement test was based on Inyang's Instrument from which the test items were adopted. The study subjects were allowed to read the instruction and explanations were made where necessary, after the completion of the tests the results were collected for analysis as follows:

A RESULT OF TEST OF INTEGRATED SCIENCE PRACTICAL SKILLS ITEM CHARACTERISTICS

The scores of pilot –test of the study subjects in test of Integrated science practical skills were collated and reliability of the instrument was determined using test-retest method. The statistical technique used was Pearson product-moment correlation coefficient (r).

The coefficient reliability of r = 0.89 was calculated. To further confirm the internal consistency of the test split-half procedure was also used. The coefficient reliability of r = 0.86 was obtained this his high to consider the test item suitable for the final testing.

The item characteristics were determined facility indicates of 0.30 to 0.70 and discriminating indices of 0.30 to 0.75 were included in this study (see section 3.6.5 of chapter III for details).

B. RESULTS OF PRE-TESTS

Test of Integrated Science Practical Skills (TOISPS) and Integrated Science Achievement Test (ISAT) scores were collated from the study subjects performance. t-test statistical technique was used to determine the mean difference of the students scores in both tests. The two tests were administered to both experimental and control group students. The result is shown in table 4.8 and table 4.9 respectively.

Table 4.8 **Comparison of the Pre–test Academic achievement of Experimental and Control Groups.**

Variable	N	$\bar{X}$	SD	SE	t-value Calculated	DF	t-value critical	P	Remark
Male	50	6.60	0.41	3.31	0.17	98	1.98	0.86	Not significant
Female	50	6.50	0.40	2.81					

From the result in table 4.8, the calculated t-value of 0.17 was obtained. This is lower than the critical t-value of 1.98 at $p \leq 0.05$, this indicates that there was no significant difference between the performance of experimental and control group students. This shows that the two groups were equivalent in their academic achievement. Therefore they were used as the study subjects.

Table 4.9 **Comparison of the Pre-test of Practical skills Performance of Experimental and Control Groups.**

Variable	N	$\bar{X}$	SD	SE	t-value calculated	DF	t-value critical	P	Remark
Experimental	50	5.60	0.26	3.13					Not
Control	50	5.40	0.28	1.92	1.85	98	1.98	0.00	significant

The result in table 4.9 shows that the calculated t-value of 1.85 was observed which is lower than the critical t-value of 1.98 this indicates that there was no significant differences in the mean scores of the experiment and control group students, therefore they are equivalent in their practical activity performance. The two groups were therefore considered for the study

Table 4.9 **Comparison of the Pre–test of Practical skills Performance of Experimental and Control Groups.**

Variable	N	$\bar{X}$	SD	SE	t-value calculated	DF	t-value critical	P	Remark
Experimental	50	5.60	0.26	3.13					Not
Control	50	5.40	0.28	1.92	1.85	98	1.98	0.00	significant

The result in table 4.9 shows that the calculated t-value of 1.85 was observed which is lower than the critical t-value of 1.98 this indicates that there was no significant differences in the mean scores of the experiment and control group students, therefore they are equivalent in their practical activity performance. The two groups were therefore considered for the study.

CONCLUSION

The pilot study was carried out to determine the item, characteristics as well as reliability coefficient of Test of Integrated Science Practical skills (TOISPS) this was necessary as suggested by Tuckman (1975) who stated that ' a test can be considered good for research work when it has been tried and its characteristic determined through pilot testing. Pre-test were also carried out to ascertain the experimental and control group students' equivalent ' performance in academic achievement and practical activity.