IMPACT OF PRACTICAL ACTIVITIES ON ATTITUDE, SKILLS ACQUISITION AND PERFORMANCE IN CHEMISTRY AMONG COLLEGES OF EDUCATION STUDENTS IN NORTH-WEST ZONE, NIGERIA

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NOVEMBER, 2015

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

DEPARTMENT OF SCIENCE EDUCATION
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ZARIA - NIGERIA

NOVEMBER, 2015

DECLARATION

I declare that this dissertation entitled "Impact of Practical Activities on Attitude, Skills Acquisition and performance in Chemistry among Colleges of Education Students, North–West Zone, Nigeria." was carried out by me in the Department of Science Education, Faculty of Education, Ahmadu Bello University Zaria. The information derived from other Literature were duly acknowledged in the text and list of references provided. No part of this work has previously been presented for another degree or diploma at this or any other institution.

_____ _____

Hadiza MUHAMMAD- LAWAL Date

CERTIFICATION

This dissertation entitled: "IMPACT OF PRACTICAL ACTIVITIES ON ATTITUDE, SKILLS ACQUISITION AND PERFORMANCE IN CHEMISTRY AMONG COLLEGES OF EDUCATION STUDENTS, NORTH –WEST ZONE, NIGERIA" written by Hadiza MUHAMMAD-LAWAL (Med/Educ./1539/2011-2012) meets the regulations governing the award of Masters Degree in Science Education of the Ahmadu Bello University Zaria and is approved for its contribution to knowledge.

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ABBREVIATIONS

BSCS: Biological Sciences Curriculum Study

BSNSS: Basic Science for Nigerian Secondary Schools

CAT: Chemistry Performance Test

CBA: Chemical Bond Approach

CESAC: Comparative Education Study and Adaptation Centre

F.M.E: Federal Ministry of Education

F.R.N: Federal Republic of Nigeria

HSD: Honest Significant Difference

N.C.E: Nigeria Certificate in Education.

NISP: Nigerian Integrated Science Project

NSSP: Nigerian Secondary School Science Project

NTI: National Teachers Institute

SACPQ: Students' Attitude towards Chemistry Practical Questionnaire

SAOCL: Skills Acquisition Observation Check List

STAN: Science Teachers Association of Nigeria

OPERATIONAL DEFINITION OF TERMS

Performance: It can be defined as outcome of student achievement which indicate the extent to which a student achieves a specific goal.

Attitude: A general expression of either positive or negative feelings towards something.

Practical Activities: Investigation students undertake using chemicals and equipment in a science laboratory to solve problems.

Skills Acquisition: Ability acquired through training to smoothly carry out complex activities.

LIST OF APPENDICES

Appendix		Page
A:	Students' Attitude Towards Chemistry Practicals Questionnaire (ATCQ)	77
B:	Skills Acquisition Observation Check List (SAOCL)	79
C:	Chemistry Performance Test	80
D:	Lesson Plan for the Experimental Group	90
E:	Lesson Plan for the Control Group	117
F:	Liquid Soap Production Manual	140
G:	Item Analysis	142
H:	ANOVA	144

LIST OF TABLES

Table Page

1.1: N.C.E III Second Semester Results from 2007/2008 -2013/2014 Academic Session 6

3.1: Population of the Study.....36

3.2: Sample for the Study.....37

3.3: Item Specification Based on Bloom's Taxonomy 39

4.1: Result of Mean Rank and Mean Rank Difference of Attitude Scores of Students in Experimental and Control Groups Before and After Exposure to Treatment 53

4.2: Result of Mean Rank and Mean Rank Difference Skills Acquisition Scores of Students in Experimental and Control Groups Before and after exposure to Treatment 54

4.3: Means and Standard Deviations of Chemistry Performance Test Scores of Experimental and Control Groups 55

4.4a: Result of Kruskal - Walis Test Scores from Attitude towards Chemistry Practical Scores in Experimental and Control Groups Before and After Treatment 55

4.4b: Result of Tukey HSD Test Analysis of Students Attitude toward Chemistry Practical Scores of Experimental and Control Groups Before and After Treatment 56

4.5a: Result of Kruskal- Wallis Analysis of Skills Acquisition Scores of Experimental and Control Groups Before and After Treatment.....57

4.5b: Result of Tukey HSD Test Analysis of Skills Acquisition Scores of Students in Experimental and Control Groups Before and After Treatment.....58

4.6: Result of t-test Analysis of Scores from Chemistry Performance Test of Students in Experimental and Control Groups 59

LIST OF FIGURES

Figure Page

3.1: Research Design.....34

3.2: Flow Chart Showing Step by Step Presentation of Concepts in Saponification....48

TABLE OF CONTENTS

Title Page i

Declaration iii

Certification iv

Acknowledgements v

Abbreviations vi

Operational Definition of Terms vii

List of Appendices viii

List of Tables ix

List of Figures x

Table of Contents xi

Abstract xiii

CHAPTER ONE : THE PROBLEM

1.1 Introduction 1

1.1.1 Theoretical Framework 5

1.2 Statement of the Problem 5

1.3 Objectives of the Study 6

1.4 Research Questions 7

1.5 Research Hypotheses 7

1.6 Significance of the Study 7

1.7 Scope of the Study 8

1.8 Basic Assumptions 9

CHAPTER TWO : LITERATURE REVIEW

2.1 Introduction 10

2.2 Nature and Teaching of Chemistry at N.C.E Level 10

2.2.1 Philosophy of Teaching Chemistry at N.C.E Level. 12

2.2.2 Objectives of Teaching Chemistry at N.C.E Level 12

2.2.3 Methods in Teaching Chemistry. 12

2.3 Curriculum Innovations in Science that emphasize the Importance of Practical activities 16

2.4 Practical Activities in Chemistry and its Objectives 18

2.5 Relationship between Practical Chemistry and Attitude toward chemistry at N.C.E Level 21
2.6 Relationship between Practical Chemistry and Skills Acquisition at N.C.E Level 23
2.7 Relationship between Practical activities in Chemistry and Performance in Chemistry at N.C.E Level 25
2.8 Overview of Similar Studies 26
2.9 Implication of Literature Reviewed to the Present Study 31
CHAPTER THREE : METHODOLOGY
3.1 Introduction 33
3.2 Research Design 33
3.3 Population of the Study 35
3.4 Sample and Sampling Technique 36
3.5 Instrumentation 37
3.5.1 Students' Attitude towards Chemistry Practical Questionnaire (SACPQ) 37
3.5.2 Skills Acquisition Observation Check List (SAOCL) 38
3.5.3 Chemistry Performance Test (CPT) 38
3.5.4 Validity of Instruments (SACPQ , SAOCL, and CPT) 39
3.5.5 Pilot Testing 40
3.5.6 Reliability of the Instruments 41
3.6 Item Analysis 42
3.7 Administration of Insruments 43
3.7.1 Administering Insruments to the Experimental Group 44
3.7.2 Teaching the Control Group 48
3.8 Procedure for Data Analysis 49
3.9 Data Analysis 49
3.9.1 Answering Research Questions 50
3.9.2 Hypotheses Testing 50
CHAPTER FOUR : DATA ANALYSIS, PRESENTATION OF RESULTS AND DISCUSSIONS
4.1 Introduction 52
4.2 Data Analysis and Presentation of Results 52
4.3 Summary of Findings 59
4.4 Discussion of Result 60

CHAPTER FIVE : SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction....63

5.2 Summary of the Study....63

5.3 Summary of Major Findings....64

5.4 Conclusions....65

5.5 Contribution to Knowledge....65

5.6 Recommendation....65

5.7 Limitations of the Study....66

5.8 Suggestions for Further Studies....66

REFERENCES....68

APPENDICES....77

ABSTRACT

This study investigated the Impact of Practical Activities on Attitude, Skills Acquisition and Performance in Chemistry among Colleges of Education Students, North –West Zone, Nigeria. Randomized experimental-control groups design involving pretest and posttest was used for the study. The population of the study comprised 1,982 NCE II Chemistry students in 12 Colleges of Education in the North- West zone. Two Colleges of Education, Isah Kaita College of Education Dutsenma and Federal College of Education Zaria were randomly selected using balloting and grouped into Experimental and Control Groups using simple random sampling technique from the population.22 students were selected from Isah Kaita College of Education Dutsenma and 38 from Federal College of Education Zaria. Three research instruments, Students Attitude toward Chemistry Practical Questionnaire (SACPQ) with reliability coefficient of 0.67, Skills Acquisition Observation Check List (SAOCL) with reliability coefficient of 0.91 and Chemistry Performance Test (CPT) with reliability coefficient of 0.87 were validated by experts and used to collect data for the study. Students in the experimental group were taught using practical activities while those in the control group were taught using lecture method. Three research questions were raised and answered using Mean Rank, Mean Rank Difference, Mean and Standard Deviation and three research hypotheses were formulated and tested using Krukal-Walis, Tukey HSD test and t- test at $p \leq 0.05$ level of significance using SPSS statistical package. The major findings from this study include the following: there was positive attitudinal change towards chemistry among students exposed to practical activities than that of their counterparts who were taught using lecture method, skills acquired and performance of students exposed to practical activities were significantly higher than those of their counterparts who were taught using lecture method. Based on the findings of the study, it was concluded that exposing N.C.E chemistry students to practical activities when teaching chemistry concepts will bring about positive attitude towards chemistry, enable them acquire skills and enhance their performance in chemistry. Based on the findings of the study, recommendations were made which includes chemistry teachers in Colleges of Education should teach chemistry concepts using practical activities among others.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Chemistry can be defined as the study of matter. It can be seen as a branch of science which deals with the study of composition, properties and uses of matter (Ababio, 2007). It probes into the principles governing the changes matter undergoes, the complexity of nature and changes that take place in the universe (Jegede, 2007).

The teaching of chemistry involves the use of process skills which are mental tools used in the discovery and acquisition of scientific knowledge. It involves conversion, procession, production, rebirth and transfiguration (Roget, 2003). It is an experimental science and its development and application demands a high standard of experimental work. Being one of the science subject chemistry is being taught in all countries of the world regardless of their level of development. It is offered at high schools, colleges and university level (Hofstein & Shore, 2004).

Chemistry has been identified as a very important science subject and its importance in science and technological development of any nation has been widely reported (Adesoji, 2008). It was as a result of the recognition given to chemistry in the development of individual and the nation that it was made a core – subject among the natural science and other science related courses in Nigerian Education system (Adesoji, 2008). It has been a pre-requisite subject for offering most science oriented courses in the tertiary institution (Ava & Odomwonyi-otu, 2011). According to Ohodo, (2005) chemistry contributes to the attainment of the aims of education and specifically helps individuals to develop effective process skills, critical thinking and competences required for dealing with observation, classification, measurement, counting numbers, recording,

communication, prediction, hypothesis, inference, experimentation, interpretation of data, research, controlling variable and generalization etc.

Practical activities can be described as the activities which students undertake using chemicals and equipment in a science laboratory. Reid and Shah (2007) discussed the rationale for practical activities in higher education and were of the view that for practical activities to be effective, the goals, aims and objectives should be well defined. Abdullahi, (2007) stated that when chemistry concepts are taught using practical activities they enhance the quality and the extent of scientific understanding that could be achieved by students while Omosewo, (2006) was of the view that a deeper understanding of the science and technology process can be achieved through practical activities, which encourage active participation and serve to develop critical thinking. Practical activities provide concrete experiences to substantiate the theoretical aspect that has been taught. Usman, (2011) believed that students with practical experience are likely to perform better than those with limited practical skills.

According to Ravinshankar and Ladage (2009), chemistry practical classes help students understand theories and chemical principles which are difficult or abstract, they offer opportunity to handle chemicals safely; gain hands- on experience in using instruments and apparatus, develop scientific practical skills and enthusiasm to chemistry, develop basic manipulative and problem solving skills. Kallats, (2001) sees practical activities as a means to verify a science principle, or theory already known to the students, a means of determining the relationship between cause and effect and a means of obtaining and learning scientific information.

Similarly, Fredrick, (2005) was of the view that the main aim of practical activities in chemistry is to : make accurate observation and description of chemical phenomena; develop specific manipulative skills ; observing problems related to

chemistry and seeking ways to solve them; develop a logical reasoning; develop self reliance; verify principles and facts already learnt; develop certain discipline techniques; develop a critical attitude; and be able to comprehend and carry out instructions. Also, Mckee, (2007) opines that meaningful learning is possible from a given laboratory experiment if the students are given ample opportunities to operate equipment and materials that help to construct their knowledge of phenomena and related scientific concepts. A laboratory activity serves as indispensable components of teaching chemistry (Hofstein & Luneta, 2004).

Attitude could be described as once feeling, thought and predisposition to behave or respond in a particular manner. According to Koballa and Glynn (2007) attitudes is a general expression of either positive or negative feelings towards something and this distinguishes it from other terms like value, belief or opinion. It may be seen as a predisposition to respond in a favorable or unfavorable manner with respect to a given object. The attitude object can be anything, such as chemistry, chemists, chemistry lessons, chemistry topics taught in school, chemical education research, and industrial chemistry(Oskamp & Schultz,2005).Attitudes are not directly observable; their existence can only be inferred from observable responses.

Skill is the ability to do something well. It is the learned ability to carry out pre-determined results often with the minimum outlay of time, energy, or both. It can also be seen as the ability that one possesses. It can be seen as an ability and capacity acquired through deliberate, systematic, and sustained effort to smoothly and adaptively carryout complex activities or job functions involving ideas (cognitive skills), things (technical skills) or people (interpersonal skills). It is the ability, usually learned and acquired through training, to perform actions, in other to achieve a desired outcome. Skills represent particular ways of using capacities in relation to environmental demands, with

human being and external situation together forming a functional system (Adeyemo, 2009). Also, Okorie, (2009) view skills as expertness, practical ability and tact or an organized sequence of action, competencies and proficiencies executed to carry out a given task. Elijah, (2006) describes skills as a well established habit of doing things.

Chemistry according to Njelita, (2007) is a practical oriented subject which demands proper exhibition of skills acquisition and concept for effective interpretation of existing phenomena. She identified the skills expected to be acquired by students in chemistry to include: (i) Using instructions (ii) measuring (volume) with burette (iii) Using indicators (iv) Using pipette (v) Taking readings and recording (vi) Using spatula (vii) Heating with Bunsen burner (viii) Handling glassware (ix) Using reagent bottles (x) Recording results of practical activities.

Baiyelo and Adeyemo, (2001) opine that skills acquisition in chemistry can be seen as the application of knowledge, theory and skills students have developed during their practical classes to complete real life tasks. Therefore, this study investigated the impact of practical activities on skills acquisition.

Performance in chemistry is defined by Chadau, (2002) as what students are able to gain after completion of instruction. It means accomplishment or proficiency of performance in a given skill or body of knowledge. Usman, (2000) describes performance in chemistry as the assessment of how much students' have learnt, the extent to which a student has acquired certain information or mastered skills usually because of planned information or training.

The N.C.E curriculum revised by the National Commission for Colleges of Education (N.C.C.E,2008) has one of its objectives, the production of competent, effective and efficient teachers, who having acquired the requisite skills should be able to impart same to their pupils, apply the skills and knowledge gained through the study of

chemistry to solve day-day problems, develop scientific attitudes, manipulate simple apparatus for the purpose of demonstration and use, view chemistry as a process of inquiry in to the world.

It can be seen from the objectives that there is a need to relate theories to practical when studying chemistry. This study, determined the impact of practical activities on attitude skills acquisition and performance in chemistry, among colleges of education students, north –west zone Nigeria.

1.1.1 Theoretical Framework

The concept of "Discovery Learning" (Bruner, 1990) that is allowing students' to learn by doing within the classroom context is a departure from traditional methods. He suggests development occurs as mental structures become more elaborate and sophisticated through interaction and experience: "learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so" (Kearsley, 2001). In this context, laboratories are important components of education to make students to gain experience. Especially when thinking that chemistry is totally an applied branch of science. In the chemistry laboratory, students become active in their learning by seeing, observing and doing. Such kinds of application cause not only a better but also a permanent learning (Temel, Oral & Avanoglu, 2000). Bruner's (1990) theory of discovery learning was adopted in this study.

1.2 Statement of the Problem

Despite the importance of chemistry in the economic and technological advancement of a nation, students' recorded low skill acquisition and poor performance in some chemistry courses. For example, Chemistry of Natural Products and Amines (CHEM 323) is one of the course taught at N.C.E level in which students' performance is very poor. Results of students from colleges of education in the North-west zone from 2007/2008-2013/2014 in this course is shown in Table1.1. This poor performance of

students in chemistry has continued to be a major concern to all. This may be due to the fact that teachers teaching N.C.E chemistry students do not give adequate attention to practical activities which in most cases is being done using demonstration method. These categories of students need to carry out practical activities by themselves to enable them acquire skills, develop positive attitude towards chemistry, and enhance their performance in chemistry. Therefore this study was set out to investigate the impact of practical activities on attitude, skill acquisition and performance in chemistry among colleges of education students' in north-west zone Nigeria.

Table 1.1: N.C.E III Second Semester Results on Chemistry of Natural Products and Amines from 2007/2008 -2013/2014 Academic Session.

Year	Number sat	Number Pass	% pass	No failed	% failed
2007/2008	118	53	44.9	65	55.1
2008/2009	140	80	57.1	60	42.9
2009/2010	114	69	60.5	45	39.5
2010/2011	122	52	42.6	70	57.4
2011/2012	110	45	40.9	65	59.1
2012/2013	182	77	42.3	105	57.7
2013/2014	285	175	61.4	110	38.6

Source: Chemistry Department Examination Office. (2007-2014) Academic Session. North-west Zone Nigeria

1.3 Objectives of the Study

The objectives of the study were to:

1. determine the impact of practical activities on the attitude of N.C.E chemistry students toward Chemistry.
2. investigate the impact of practical activities on N.C.E chemistry students' skills acquisition.
3. examine impact of practical activities on N.C.E students' performance in chemistry.

1.4 Research Questions

The following research questions were raised and answered:

1. What is the difference between the attitudinal change of N.C.E chemistry students exposed to practical activities and those taught using lecture method?
2. What is the difference between the level of skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method?
3. What is the difference between performance in chemistry of students' exposed to practical activities and those taught using lecture method?

1.5 Research Hypotheses

The following null hypotheses were formulated and tested at $p \leq 0.05$ level of significance:

Ho_1: There is no significant difference between the attitudinal change of N.C.E chemistry students exposed to practical activities and those taught using lecture method.

Ho_2: There is no significant difference between skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method.

$H_{O3:}$ There is no significant difference between performance of N.C.E chemistry students exposed to practical activities in chemistry and those taught using lecture method.

1.6 Significance of the Study

The findings of this research work are hopefully to benefit the laboratory instructors, students, teachers, researchers, curriculum developers and parents in the following ways:

It might help chemistry laboratory instructors to see advantage of involving students in every step of the laboratory experiment so as to give ample opportunities to use scientific equipment to develop basic practical skills, practice investigative or inquiry activities and develop well in science.

It might enable chemistry students to see chemistry as a means of acquiring basic practical skills to enable them manipulate equipments in the laboratory, develop problem solving skills to solve their day to day problem, enhance their performance, see chemistry as real not abstract, and change their attitude positively towards studying chemistry.

It might help chemistry teachers in colleges of education to see the importance of relating theories to practical in teaching chemistry so as to equip their students with practical skills which will make them productive after school and enhance their performance.

Curriculum developers might see the findings of this research useful when planning their curriculum to reorient or reorganize their curriculum towards a better preparation for better professional development of the students.

Researchers who may wish to carry out research in similar field might use the findings of this study as an important source of literature to their study. Also, parents whose children are studying chemistry might see the importance of practical activities in chemistry.

Professional bodies such as Science Teachers Association of Nigeria (STAN) might see the findings of this study as a source of use full information for effective teaching of science in schools.

1.7 Scope of the Study

In this study the researcher carried out research on the effects of practical activities in chemistry on students' attitude, skills acquisition and performance among N.C.E II chemistry students in Federal College of Education Zaria and College of Education Dutsenma Katsina. N.C.E II chemistry students were chosen because N.C.E I students are newly introduced into N.C.E chemistry, N.C.E III students are busy with their projects and teaching practice exercise. The study was restricted to the following

chemistry concepts: Esters, Fats, Oils, Alkaline Hydrolysis of Fats and Oil (saponification) and Liquid Soap Production because it is part of their course in N.C.E III (Chemistry of Natural Products and Amines CHE 323) and there is no provision for it to be done in their practical courses in the N.C.E curriculum. The teaching process in this study lasted for 6 weeks with 2-hours interaction weekly. The instruments used in carrying out the study were students' attitude towards chemistry practical questionnaire (SACPQ) which consists of 20 item, skills acquisition observation check list (SAOCL) which consists of 20 item, chemistry performance test (CPT) which consists of 50 item.

1.8 Basic Assumptions

The following assumptions were made for the purpose of this study:

All N.C.E II students have the same qualifying bodies, same curriculum and all colleges of education have facilities for practical work in chemistry. N.C.E II chemistry students acquire enough skills during their practical classes and the acquisition of these skills brings about positive attitude towards studying chemistry which in turn enhances students' performance, they have been exposed to the same experimental condition during their practical classes and are able to use the skills acquired during their practical activities to participate effectively in science.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The study is aimed at determining the impact of practical activities on attitude, skills acquisition and performance in chemistry among colleges of education students. This chapter therefore, discussed the literature reviewed and it is presented in the following sub-headings:

- Teaching of Chemistry at N.C.E Level
- Curriculum Innovation in science that emphasize Importance of Practical activities
- Practical activities in Chemistry and its Objectives
- Relationship Between Practical Chemistry and Performance at N.C.E Level
- Relationship between Practical Chemistry and Skills acquisition at N.C.E Level
- Relationship between Practical Chemistry and Attitude at N.C.E Level
- Overview of Similar Studies
- Implication of the Literature Reviewed on Present Study

2.2 Nature and Teaching of Chemistry at N.C.E Level

Chemistry is the science of matter and the changes it undergoes. It is concerned with the composition, behavior, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. It is a physical science which studies various substances, atoms, molecules, crystals and other aggregates of matter whether in isolations or in combination which incorporates the concepts of energy and entropy in relation to the spontaneity of chemical processes (Jegede 2007).

Chemistry has been identified as a very important science subject and its importance in science and technological development of any nation has been widely

reported (Adesoji, 2008). It was as a result of the recognition given to chemistry in the development of individual and the nation that it was made a core – subject among the natural science and other science related courses in Nigeria education system (Adesoji, 2008). It has been a pre-requisite subject for offering most science oriented courses in the tertiary institution (Ava &Odomwonyi-otu, 2011).

Chemistry according to Njelita, (2007) is a practical oriented subject which demands proper exhibition of science process skills acquisition and concept for effective interpretation of existing phenomena. Owoyemi and Olowofela (2012), gave three major dimensions of chemistry as follow;

1) The content or body of knowledge which include facts, principles, law and theories.
2) The processes or the ways and means by which the knowledge is acquired.
3) The attitude component that is scientific attitude, ethics, interest and values.

According to (Adesoji, 2000) the frame work of chemistry in the science curriculum has been built on the students' acquisition of knowledge and understanding of

1) Scientific phenomena
2) Scientific vocabulary, terminologies and conventions
3) Scientific and mathematics measurement and safety aspects.
4) Scientific and technological applications with their sociological, economic and environmental implications

The achievement of students in chemistry curriculum is determined by;

1) High caliber of cognitive and material students.
2) Availability of academically, competent, professionally sound and endurably committed teachers.
3) Provision of moderately equipped libraries and laboratories.

4) Reasonable teacher-student ratio and well trained laboratory technologists (Ajala, 2002).Chemistry education is expected to prepare its recipient for the achievement of life goals.

2.2.1 Philosophy of Teaching Chemistry at N.C.E Level.

The intrinsic values as well as the utility values of chemistry in all spheres of human activities have necessitated its inclusion in the curriculum. The teaching and learning of chemistry at the Nigeria Certificate in Education (N.C.E) level should be such as to produce competent, effective and efficient teachers, who having acquired the requisite skills should be able to impart same to their pupils. (F.R.N, 2008).

2.2.2 Objectives of Teaching Chemistry at N.C.E Level

The objectives of teaching chemistry at N.C.E level according to F.R.N (2008) are:

To produce competent, effective and efficient teachers, who having acquired the requisite skills should be able to impart same to their pupils, produce highly qualified middle-level manpower knowledge in the process of chemistry and capable of inculcating these in the students'. Develop functional knowledge of chemistry concepts and principles, observe and explore the chemical environment, apply the skills and knowledge gained through the study of chemistry to solve day-day problems, explain simple natural phenomena, develop scientific attitudes, manipulate simple apparatus for the purpose of demonstration and usage.

2.2.3 Methods in Teaching Chemistry

Teaching can be referred to the general pedagogy in carrying out instruction. According to Atadoga and Onaolapo, (2008) it can be seen as the general approach of a teacher as regard to presentation of contents which could be determined by philosophical conviction of the goal for teaching the subject and his own personal orientation.

Owoyemi and Olowofela (2012), also opined that a suitable method for teaching chemistry must take into consideration the objectives and philosophy of the course, nature of the student, available school facilities and the entire learning climate.

Therefore an acceptable teaching style for successful chemistry education should;

1) Emphasize the individuality of the learner, his unique natural, as well as his cognitive and deontological levels of development.
2) Assist the students to gain knowledge and skills in content as well as enhance his understanding, appreciation and interest in nature and natural phenomena.
3) Encourage students' participation in the learning process while teacher relating positively and enthusiastically with the students thereby serving as a guide in the learning process.
4) Should foster initiative, creativity and resourcefulness in the student (FME, 2004).

The National Policy on Education (FRN 2004), stipulates that the best method for teaching science should be inquiry/discovery approach. This approach to instruction demands a very cordial teacher-student interaction dominated by the student. The role of the teacher is that of a facilitator rather than a dispenser of knowledge.

These teaching Methods are discussed below;

Inquiry Method: Kassim, (2002) defined inquiry method as an unstructured exploration in the laboratory where students through their mental processes such as observing, measuring, classifying e.t.c draw general conclusion with guidance of the teacher, from data which they have gathered. He also described the inquiry method as a method use in encouraging learners to discover relationship and method of solving problems by themselves make their own generalization and draw conclusion and thus be better prepared to make wider application of material learned. The method provides firsthand experience to pupils in getting facts, concept, principle and processes through the use of

mental processes and manipulating science equipment and materials. It emphasizes pupils' involvement in the learning process and enhances their ability to observe, classify, measure, predict and infer.

The inquiry method is often synonymous with the laboratory method since it involves the use of experimentation in the laboratory to impart the scientific knowledge to students. Hofstein, (2004) opines that Inquiry is a multifaceted activities that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyse, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of explanations.

Laboratory Approach: this is an activity – based teaching method which is usually carried out by one or more persons through the experimental approach. Joshi, (2008) was of the view that most of laboratory approaches fall into about five categories namely: verification and deduction laboratory approach, inductive laboratory approach, science process oriented laboratory approach and exploratory approach.

The verification and deductive laboratory approach is geared towards illustrating concepts, principle and laws and the inductive laboratory approach is oriented at providing student with the opportunity to form concepts, and principles and laws through firsthand experiences in project.

The science process oriented laboratory approach is designed to stress the vitality of the science process skills of observing, classifying, measuring, predicting, interpreting data and experimenting. The technical skills laboratory approach is designed to stress the need for acquiring manipulative skills that involve the development of hand-eye

coordination such as focusing a microscope, pipetting, measuring angles etc. The exploratory laboratory approach is meant to allow student to explore a principle without structural procedures, since they are given the freedom to explore.

Problem Solving Approach: this is seen as a method of solving a problem scientifically: it constitutes one of those methods of discovering learning; it is largely designed to discourage traditional demonstration methods; it does not lay emphasis in the use of laboratory experiments. It is an authentic investigatory solution – seeking method. Joshi (2008) discloses that problem – solving teaching procedure is a process of raising a problem in the minds of student in such way as to stimulate purposeful and reflective thinking in arriving at a rational situation. The methods of problem solving approach in the student are exploration, questioning, inductive reasoning, and invention and there are sequences of steps that must be adhered to in order to address an issue or problem through the problem-solving. Thus student and teacher are usually advised to become aware of the steps established in the problem-solving method.

The following steps are involved:

- identifying and defining a problem;
- formulaeting hypotheses;
- data collection;
- testing hypotheses by evaluating data;
- interpretation of result; and
- drawing conclusions.

Laboratory approach (Practical activities) which is designed to stress the need for acquiring manipulative skills that involve the development of hand-eye coordination was used in teaching saponification concept for the purpose of this study.

2.3 Curriculum Innovations in Science that emphasize the Importance of Practical activities

Basic Science for Nigerian Secondary Schools was an effort to develop a systematic curriculum for Nigerian secondary schools which incorporate all science subjects with adequate lecture materials, methodology and evaluation strategies. It was the first science curriculum development project undertaken in Nigeria between 1963-1967. The BSNSS was a curriculum in General Science which covered the first two years of secondary school. The syllabus was conceived to be child-centered with emphasis on the discovery teaching method and with laboratory oriented activities.

The philosophy of the project was "doing science the way scientists do it". That is observing carefully, reporting honestly what is observed and being patient. The project was broken up into pupil's activities i.e. the pupils would actually do science and not learning about science only. Ogunleye, (1999) stated that the approach was that:

- students should learn science by sciencing
- students experience discovering facts themselves
- carry out processes as scientists do.

Nuffield Science Projects Combined Science is a method of introducing children to natural phenomena and the ways in which the children themselves can interpret these phenomena. It was an attempt to recapture the unity of outlook and consistency of method which belong to the whole of Science.

Chemical Bond Approach an American based curriculum reform project initiated to serve as a method of teaching which emphasize the teaching of chemistry using practical activities. It is an attempt to produce a study of chemistry that will reveal the importance of theory and experiment (practical activities) in facilitating the teaching and learning of chemistry.

The objectives of CBA curriculum according to Michaelis (1970), was to ;

1. understand the possibilities of fitting ideas and observations together to bring about new experiences.
2. stimulate students taught through inquiry
3. enable students raise critical questions and to organize and account for sources of errors.

These require practical activities which provide an opportunity for relating taught, ideas and experimentation in an integrated manner.

It is clear that before the emergence of CBA emphasis has been more on role learning of chemical concepts.

Biological Science Curriculum Studies (BCSC) was established in January 1959 as a means of contributing to the improvement of secondary school biology education. The pedagogical approaches of the project emphasized investigation and inquiry as a means of acquiring knowledge in science.

Physical Science Studies Committee, this committee clamoured the teaching of physics by student centred approach. Its emphasis was on the use of laboratories as the place where students will first gain experience of science phenomena and then discuss the theory governing their observation in the classroom setting. The method is aimed at promoting the development of positive attitude and skills of the scientists.

Havard Physics Project: This project was initiated basically to provide better ways of teaching and learning physics. The aims of this project according to Lindley, (2010) were to:

1. help students increase their knowledge of physical world by concentrating on ideas that characterizes physics as a science subject rather than concentrating on isolated bits of information.

2. help students see physics as the wonderful human activities that it really is.

3. enable students gain knowledge and skills that was useful in the long run.

These innovation projects started and led to provision of adequate materials and intensive campaign which helped in the improvement of science instruction at primary and secondary levels of education.

The innovations bring about vital change in pedagogy from traditional content and factual knowledge approach to that of students' active involvement in learning science by doing. In Nigeria, the Science projects that emphasized practical activities are: The Nigerian Secondary School Science Project (NSSP) developed by Comparative Education Study and Adaptation Centre (CESAC), Nigeria Integrated Science Project (NISP) developed by Science Teachers Association of Nigeria (STAN).

This study therefore, investigated the impact of practical activities on Attitude, skills acquisition and performance in chemistry among colleges of education chemistry students, North-West Zone Nigeria.

2.4 Practical Activities in Chemistry and its Objectives

Practical activities are seen as activities students undertake in the laboratory using equipments and reagents. According to Lunetta, Hofstein and Clough, (2007) , practical activities is a learning experience which enables students interact with materials or with secondary sources of data to observe and understand the natural world. It is a teaching and learning activity which involves the students in observing or manipulating the objects and materials they are studying. (Millar, 2004).

One of the objectives of practical activities in chemistry is to enable students manipulate scientific equipments and material. According to Dillon, (2008) the objectives of practical activities in chemistry are to;

- encourage accurate observation and description;

- make phenomena more real;
- arouse and maintain interest;
- promote a logical and reasoning method of taught.
- practice seeing problems and seeking ways to solve them;
- develop a critical attitude;
- develop an ability to cooperate;
- find facts and arriving at new principles.

Tafa (2012), also identified the objectives of practical activities in chemistry as follows; to

- improve mastery of the subject matter
- develop scientific reasoning
- demonstrate materials taught in lecture
- build up practical skills•
- design experiments to test
- interpret experimental data
- promote interest in chemistry
- formulaete hypothesis
- work out problems
- introduce equipment and develop observational skills.

In an attempt to make sense of the various aims, Dillon (2008) offers a 'crude summary of arguments' for the use of practical activities to include;

Cognitive arguments: It is argued that practical activities can improve pupils' understanding of science and promote their conceptual development by allowing them to 'visualize' the laws and theories of science. It can illustrate, verify or affirm 'theory work'.

Affective arguments: Practical activities, it has been argued, is motivating and exciting – it generates interest and enthusiasm. It helps learners to remember things; it helps to 'make it stick'.

Skills arguments: It is argued that practical activities develops not only manipulative or manual dexterity skills, but also promotes higher-level, transferable skills such as observation, measurement, prediction and inference. These transferable skills are said not only to be valuable to future scientists but also to possess general utility and vocational value.

Achimugu, (2012) stated the objectives of practical activities in chemistry as follows:

i. It helps students develop science process skills such as observing, classifying, predicting, measuring, drawing, recording data, hypothesizing, etc.

ii. It promotes the development of scientific attitudes such as objectivity, honesty, curiosity, patience, open-mindedness, etc.

iii. It helps students to understand and appreciate the spirit and methods of science such as problem solving, analytic minds and methods of science.

iv. It is used to reinforce what is learnt in the theory class and hence encourages the spirit of experimentation.

v. It arouses and maintains interest and curiosity in chemistry.

vi. It helps students to develop manipulative skills and proficiency in writing reports.

vii. It enhances students' better understanding of concepts and principles and by so doing, significantly contributes to students achievements in chemistry.

viii. It encourages students to be active in the class, in other hand, discourages abstraction, rote memorization and inattentiveness in the class.

ix. It leads to fundamental and applied research in chemistry at all levels of education.

x. It helps to verify laws and theories that the students have already learnt.

Looking at the objectives of practical activities stated above the researcher used practical activity to teach saponification concept in chemistry in order to examine its impact on attitude, skills acquisition and performance in chemistry among colleges of education students, North –West Zone Nigeria.

2.5 Relationship between Practical Chemistry and Attitude towards Chemistry at N.C.E Level

Attitudes are general expression of either positive or negative feelings towards something and this distinguishes it from other terms like value, belief or opinion (Koballa & Glynn, 2007). Developing favourable attitudes towards science has often been listed as one of the important goal of science teaching. Hofstein and Lunetta, (2004) have suggested that the laboratory, as a unique social setting, has (when activities are organized effectively) great potential in enhancing social interactions that can contribute positively to developing attitudes and cognitive growth.

Attitude associated with science (chemistry) appears to effect students' participation in science as a subject and their performance in chemistry (Jegede 2007). Students enjoyed conducting practical activities but it is argued that this is because they preferred it to other learning activities, just as they would for visit to a science education centre. Practical activities and science educational visits can create enjoyment and/or have a positive impact on students' learning of science as seen through some research Abraham, (2009).

The science education literature emphasize that laboratory work is an important medium for enhancing attitudes, stimulating interest and enjoyment, and motivating students to learn science in general and chemistry in particular (Thompson & Soyibo, 2002).

Hofstein, (2004) reported that students enjoy laboratory work in some courses and that laboratory experiences resulted in positive and improved student attitudes and interest in science. He was also of the view that chemistry students who were asked to rate their perceptions of the relative effectiveness of instructional methods for promoting their interest in and attitude towards learning chemistry. They reported that personal involvement in the chemistry laboratory was the most effective instructional method for promoting their interest in chemistry studies when contrasted with teachers' demonstrations, filmed experiments, classroom discussions, and teacher's lectures. In addition, in a study in which they explored the reasons for students' enrolment in more advanced (post-compulsory) courses in high-school chemistry, they found that one of the key reasons was their experiences with practical exercises in the chemistry laboratory.

Brodie, (2001) and Williams, (2004) find significant relationships between attitude to a subject and achievement in that subject. Akinola (2003) similarly, stresses that attitude has a greater influence on aspects of learning which are emphasized in the classroom. Student beliefs and attitudes have the potential to either facilitate or inhibit learning.

It is in line with the relationship that exists between practical activities in chemistry and attitude that the researcher exposed students' in the experimental group to practical activities when teaching saponification concepts to determine its impact on their attitudinal change towards chemistry.

2.6 Relationship between Practical Chemistry and Skills Acquisition at N.C.E Level

Skills acquisition can be seen as an organized sequence of action learned through deliberate and systematic effort. Hofstein, (2004) opines that meaningful learning is possible in the laboratory if the students are given opportunities to manipulate equipment and materials in an environment suitable for them to construct their knowledge of phenomena and related scientific concepts. He was also of the view that appropriate laboratory activities can be effective in promoting cognitive skills, Meta-cognitive skills, practical skills, attitude and interest towards learning chemistry. In addition, it is clear that providing students with practical learning experiences has the potential to vary the classroom learning environment and thus to enhance students motivation to study science (chemistry).

Practical oriented courses would enable pupils to design and carry out experiments including appropriate form of measurement of skills, aptitudes and work satisfactoriness. This would enable them in the final analysis to manage and organize practical activities and resources, and break ideas and concepts of skills/ work down to manageable parts (Adeyemo, 2009).

Hofstien, (2004) was of the view that the laboratory instruction is an effective and efficient teaching medium to attain some of the goals for teaching and learning science and appropriate practical activities can be effective in helping students construct their knowledge, develop logical and inquiry-type skills, as well as problem-solving abilities. They can also assist in the development of psychomotor skills (manipulative and observational skills). In addition, they have a great potential in promoting positive attitudes and in providing students with opportunities to develop skills regarding cooperation and communication. In this respect the science laboratory is a unique

learning environment. Thus, it has the potential to provide science teachers with opportunities to vary their instructional techniques and to avoid a monotonous classroom learning environment.

Studies by Ibe and Nwosu, (2003) and Okoli, (2006) asserts that when one acquires the science process skills of observing, measuring, questioning, designing experiments, interpreting data etc, such a person becomes specially equipped with the tools required for scientific inquiry or problem solving as well as ability to use these skills in the laboratory for a variety of investigation.

Similarly, (Odili, 2004) opines that Practical activities presume to be capable of fully involving the individual learner in the learning and teaching activities as well as help to remove individual differences and absent –mindedness. He was of the view that the singular privilege of manipulating the apparatus to obtain the desired result which the laboratory method of learning offers, plays a very important role in motivating the learners and making teaching lively. Bugaje, (2013) was of the view that practical activities in chemistry provides learners with opportunities to use scientific equipment to develop basic manipulative skills practice investigative or inquire activities and develop problem solving attitude needed for future work in science.

It is in line with the relationship that exists between practical activities in chemistry and skills acquisition that the researcher exposed the students' to practical activities when teaching saponification concepts to determine its impact on skills acquisition among colleges of education students.

2.7 Relationship between Practical activities in Chemistry and Performance in Chemistry at N.C.E Level

Practical activities are activities carried out in the laboratory using reagents, equipment and materials while performance in chemistry can be seen as what students are able to attain after completion of an instruction. Omwirheren, (2009) reported that students encounter problems in chemistry practical in respective of their academic ability and mode of instruction and therefore called for proper theoretical orientation with activities based instruction.

Buraimoh and Ogunmade, (2000) in their study emphasize the importance of practical in facilitating learning for understanding and help to reinforce the principles been studied in chemistry. The authors also pointed out that chemistry practical helps students to develop certain skills such as measurement and accuracy.

Nzewi, (2008) was of the view that practical activities can be regarded as a strategy that could be adopted to make the task of teaching more real to students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters, he was of the view that practical activities should engage the students in practical, mind-on activities, using varieties of instructional materials/ equipment to drive the lesson home so as to bring about high achievement in the subject.

It is in line with the relationship that exists between practical activities in chemistry and performance that the researcher exposed the students' to practical activities when teaching saponification concepts to determine its impact on performance in chemistry.

2.8 Overview of Similar Studies

Number of studies carried out on practical activities in chemistry and attitude, skills acquisition and performance in chemistry include the following

Erden, (2012) carried out a research to examine the changes in attitude towards chemistry in Turkey. The study comprises of 29 students in their 4^{th} class of the teaching. A scale of attitude towards chemistry and test anxiety was used as instruments for data collection and correlation analysis was used to analyse the data. He finds out that low and insignificant relation was observed between the attitude – performance in chemistry, anxiety – performance in chemistry and attitude – anxiety of students. Also, an inverse relation was determined between attitude and anxiety scores.

In a research carried out by Berg, (2005) to study Student's attitude towards learning chemistry in the University level and their motivation from three perspectives using an attitude questionnaire and interviews to assess the views of knowledge, learning assessments, laboratory activities and perceived roles of instructors and students was use to estimate students' attitude position. The study involved 233 students. In his study, he finds out that the stimulation bring about a more theoretical focus during laboratory work, students with negative attitude shifts expressed negative views of educational factors much more frequently and more emphatically than students with positive attitude changes who expressed more positive views, pre – lab exercise give students a more coherent understanding of theory connected to the laboratory activities positively affect their use of theory related to the practical laboratory work. The students that had undertaken the pre-lab exercise also showed a deeper understanding of what they had done and could make better use of their chemistry knowledge.

Festus and Ekpete, (2012) used problem based solving techniques to examine its influence on students' performance and attitude towards chemistry in Obio/Akpor Local

Government of River State, 98 senior secondary school students were used for the study. A researcher developed 12 – Test items questionnaire was used for data collection and t – Test was used as the statistical tool for data analysis. Result shows that students taught using problem based solving techniques had better perceptions and attitude towards studying chemistry. They were of the view that acceptable methods of instructions are capable of changing students' attitude and performance towards chemistry.

Anders and Berg, (2005) used 66 first year chemistry university students' to gain insight about factors related to observed attitude change towards learning chemistry among university students. The research was carried out in Sweden and the research instrument use for the study was an attitude questionnaire and interviews which were analysed using principal component analysis. Results revealed that a positive attitude change was associated with evidence of motivated behaviour, while a negative change was linked to less motivated behaviour. The same was also addressed in educational settings but here students with positive attitude changes exhibited fewer negative views of educational factors, while students with negative attitude changes showed an opposite pattern.

Mohammed, (2013) conducted a research to study the attitude of students towards the three categories of questions in WAEC practical chemistry examination in Zaria Inspectorate Division of Kaduna State. The study involved 50 S.S.III Science students in public schools. The research instruments used for data collection was students' attitude inventory questionnaire in the three categories of questions in WAEC practical chemistry examination. The data generated was then analysed using ANOVA one way analysis of variance. Results from the study revealed that there is significant difference in the attitude of students towards the three categories of questions in WAEC practical chemistry

examination and students have positive attitude towards theory of practical, qualitative analysis and quantitative analysis.

Kipnis and Hofstein, (2003) Hofstein, Kipnis, and Shore, (2004) in their study administered a questionnaire which two groups of students were compared. The first group consisted of students who performed inquiry-type chemistry experiments whereas the other group comprised students whose laboratories mainly consisted of confirmatory-type experiments. It was found that in general, the students who were involved in the inquiry-type practical experiences developed a much more positive attitude towards learning chemistry in general and towards learning chemistry in a laboratory setting in particular compared to another group (control).

Orado, (2009) carried out a study aimed at examining the way practical activities are conducted in secondary schools in Kenya. It examined whether the way practical experiences were presented to the students and student's engagement in them enhanced the attainment of goals of practical activities among secondary schools students' in Nairobi Province, Kenya using 29 chemistry teachers and 309 Form 3-chemistry students. The research instruments used for the data collection were questionnaire, lesson observation schedule, document guide and SPSS version 100 was used for data analysis. Results revealed that science laboratory in secondary schools in Nairobi province were fairly equipped with basic apparatus, chemicals and materials students were involved in a variety of practical activities in chemistry which fosters the acquisition of basic scientific skills. Key scientific skills such as experimental design and hypothesis formulation were found lacking during laboratory work.

Yadav and Mishra, (2013) compare the effect of laboratory approach on university students' development of science process skills and conceptual achievement using 40 Shrikanwarata public schools students in Mandleshwar. The researchers' used science

process skills test and force concept inventory to compare skills and conceptual achievement of both the control and the experimental group students'. The data collected were analysed using mean, standard deviation and t-test. Results revealed that the achievement of the students who were taught using the laboratory approach was significantly higher than those who were taught using the traditional approach and the development of process skills were higher in the students who were taught using the laboratory approach.

Oloyede, (2012) investigate the relationship between acquisition of science process skills and achievement in chemistry using 320 S.S.II senior secondary school students from Bauchi state Nigeria. The researcher used test of logical thinking test on process skills and the students S.S.I examination results in chemistry as instruments for data collection. The data collected were analysed using Product Moment Correlation Co-efficient and result revealed that positive relationship exists between formal reasoning ability and acquisition of process skills, formal reasoning and Chemistry Performance, acquisition of science process skill and Chemistry Performance.

Chebii, Wachanga and Kiboss, (2013) investigate the effectiveness of science process skills mastery learning approach on students' acquisition of practical skills using 160- Form two students from 4-co-educational schools in Koibatek district in Kenya. The researchers used Science processes skills performance test and classroom observation schedule as the research instruments for data collection and the data were analysed using mean, ANCOVA, ANOVA and standard deviation. Results revealed that students in the experimental group outperform students in the control group in the acquisition of some selected chemistry practical skills.

Nwanko and Okoye, (2011) carried out a study to identify students' perceptions of factors influencing acquisition of process skills in chemistry using 440 S.S.I chemistry

students from Ogidi zone of Anambra state. Questionnaires were used for data collection and the data were analysed using z-test statistics. Results revealed that students do not have enough time for their class work and their course materials are not covered due to broad curriculum, lack of quality Science teachers and large school population.

Arokoyu and Prince, (2012) used 40 S.S.II students in Ogu-Bolo Local Government Area of River State to investigate the effect of demonstration approach of teaching chemistry on creativity and process skills for self-reliance. The research instrument use for collecting data were creativity ability test and Science process skills acquisition test which was analysed using t-Test. Results revealed that high, average and low creative ability students performed significantly better when taught using the student-teacher demonstration approach than those taught using teacher demonstration approach.

Donnell, O'connor and Seery, (2007) used problem based learning Mini Projects in place of traditional laboratory practical for 42, Level 2- degree students studying for an ordinary degree in physical and life science (chemical option). During their study, the students were grouped and each group was assigned a project title and a member of academic staff as project supervisor. The students' were asked to derive the experiment protocol to carry out the project. In the study, the effectiveness of the PBL – mini project was evaluated using a post – lab questionnaire, examination of students' reflections', staff interviews and informal feedback from students. They concluded that problem-based learning mini-projects complements the existing traditional laboratory approach and provide students with stimulating real – life problems to tackle. In small groups, it improves class morale and better prepares the students for their individual research project in their third year as a result of their participation in the PBL mini-project the year before.

Nbina, (2013) conduct a study to assess the relative effectiveness of guided discovery and demonstration teaching method on achievement of chemistry students of different level of scientific literacy using one hundred and forty five Senior Secondary Two (S.S.II) chemistry students from six intact classes in Portharcourt education zone of River State. Two instruments were used for data collection i.e. Chemistry Performance Test (CAT) and Scientific Literacy Test (SLT). The data collected were analysed using Analysis of Covariance (ANCOVA). Results show that the guided discovery method is superior to demonstration method in promoting cognitive achievement in chemistry among students of all levels of scientific literacy level and that for the guided discovery method, the higher the scientific literacy levels, the higher the achievement of students in chemistry.

Tath and Aya,(2011) uses constructed virtual chemistry laboratory to examine its effect on students' achievement using 90 students and one experienced teacher from one high school in Tukey. 3 research instruments were used for the study (Chemical Change Unit Achievement Test (CCUA) Laboratory Equipment Test (LET) and Unstructured Observations and a Semi-Structured Interviews). t-Test was use to compare the groups and one way ANOVA was carried for data analysis. Results revealed that the developed virtual chemistry laboratory software is at least as effective as the real laboratory both in terms of students' achievement in the unit and students' ability to recognize laboratory equipment.

2.9 Implication of Literature Reviewed to the Present Study

In the literature, many studies carried out revealed that practical activities in chemistry is an important aspect of chemistry which needs to be incorporated in every level of teaching chemistry in order to enable the students develop positive attitude

towards the subject, acquire different skills, and bring about high performance in chemistry in the subject.

The literature revealed that students' exposed to practical activities develop positive attitude towards the subject than those who are not, perform better than those who are not, but the aspect of skills acquisition which when incorporated in to teaching and learning process brings about acquisition of entrepreneurial skills that could lead to Job creation, different innovation, enable the teacher to impact chemistry knowledge effectively on learners and which the Federal Government is laying more emphasis on at each level of education was not well addressed. The present study therefore, was undertaken using practical activities to teach saponification concept in order to determine its impact on Attitude, skills acquisition and performance in chemistry among N.C.E chemistry students.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study aimed at investigating the impact of practical activities on attitude, skills acquisition and performance in chemistry among colleges of education students in North- west zone Nigeria. This chapter presents the methodology used for this study under the following sub-headings:

- Research Design
- Population of the Study
- Sample and Sampling Technique
- Instrumentation
- Validity of the Instruments
- Pilot Testing
- Reliability of the Instruments
- Administration of Treatment
- Data Collection Procedure
- Procedure

3.2 Research Design

Randomised experimental-control group design involving pretest and posttest was used for this study. Before administration of treatment, both experimental and control groups were pretested (O_1) on attitude to determine their attitude towards chemistry, pretested on skills acquisition to determine the level of skills they acquire, and on performance to determine their ability before treatment. Students in the experimental group were taught using practical activities ($\mathbf{X_1}$) while those in the control group were

taught using lecture method ($\mathbf{X_o}$). Posttest **(O)** was administered after treatment to determine the students' attitude, skills acquisition and performance after treatment. The research design is presented in Fig. 3.1

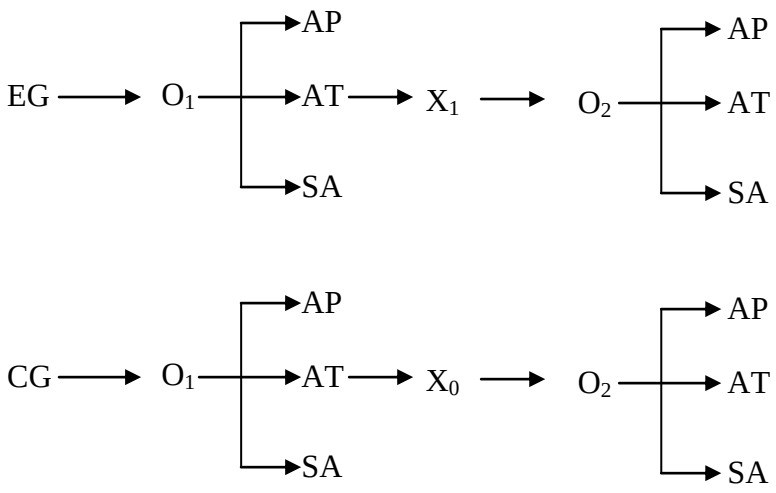


Fig. 3.1: Research Design

Key:

EG= Experimental group

CG=Control group

X_1=Practical activities

X_0= Lecture Method.

O_1= Pre-test

O_2= Post-test

AC=Performance in chemistry

AT=Attitude

SA=Skills acquisition

3.3 Population of the Study

The population of the study comprised all N.C.E II 2015 chemistry students in 12-colleges of education in North-west zone Nigeria. These colleges are both Federal and State Colleges of Educations in Kano State, Kaduna State, Kastina State, Kebbi state, Sokoto State, Jigawa State and Zamfara State. There was total number of 1,982 N.C.E II chemistry students enrolled in the 12- colleges of education. 70 students in Federal College of Education Kano, 230 Students in Sa'adatu Rimi College of Education Kumbotso, 210 students in Federal College of Education Technical Bichi Kano State, 162 students in Kaduna State College of Education Gidan waya, 160 students in Isah Kaita College of Education Dutsenma Kastina State, 392 students in Federal College of Education Zaria Kaduna State , 200 students in Federal College of Education Katsina , 190 students in Federal College of Education Technical Gusau Zamfara State, 86 students in College of Education Maru Zamfara State, 75 students in College of Education Gumel Jigawa State, 120 students in College of Education Argungun Kebbi State and 87 students in Shehu Shagari College of Education Sokoto state. These colleges of Educations are under the same commission therefore, share the same syllabus. Details of the population of this study is summarized in Table 3.1

Table 3.1: Population of the Study

S/N	Colleges of Education in North- West Zone Nigeria	Population of N.C.E II Students
1.	FCE Kano State	70
2.	Sa'adatu Rimi College of Education Kano State	230
3.	FCET Bichi Kano State	210
4.	Kaduna State College of Education Gidan Waya	162
5.	IKCOE Dutsinma Katsina State	160 392
6.	FCE Zaria Kaduna State	200
7.	FCE Katsina State	190
8.	FCET Gusau Zamfara State	
9.	College of Education Maru, Zamfara State.	86
10.	College of Education Gumel Jigawa State	75
11	College of Education Argungun, Kebbi State	120
12.	Shehu Shagari College of Education Sokoto State	87
	Total	1,982

Source: Respective College of Education Academic Office, (2015).

3.4 Sample and Sampling Technique

There are seven states in the North- West Zone and one College of Education was selected from each state using simple random sampling technique. NCE II chemistry students in the seven Colleges of Education were subjected to pretest using Chemistry Performance Test (CPT) and the results of the pretest was analysed using ANOVA and Sheffe's test to determine those who do not differ significantly in their ability level. The result of the ANOVA which is presented in appendix E revealed that there were differences in the ability of the students but the differences were not significant. Therefore, two Colleges of Education were randomly selected using simple random technique. The Colleges selected were Isah Kaita College of Education Dutsinma Kastina State and Federal College of Education Zaria Kaduna state. To categorise these colleges into experimental and control groups, same simple random sampling procedure was used

in which the first picked was tagged experimental group while the second was labelled control group. 38 students were randomly selected from Federal College of Education Zaria Kaduna state and 22 students were selected from Isah Kaita College of Education Dutsenma Kastina State using random sampling procedure. The choice of 60 students as a sample size is in line with central limit theorem which recommended minimum of 30 sample size as recommended by (Tuckman, 1975 & Fraenkel & Wallen 2000). They recommended that the minimum of 30 sample size could be used for experimental research and the study is experimental. The detail of the sample is presented in Table 3.2

Table 3.2: Sample for the Study

School	No of Students Male	Female	Total	Group
FCE Zaria	23	15	38	Experimental
IKCOE Katsina	12	10	22	Control
Total	35	25	60	

3.5 Instrumentation

For the purpose of this study, three research instruments were used. The instruments are:

- Students Attitude towards Chemistry Practical Questionnaire (SACPQ).
- Skills Acquisition Observation Check List(SAOCL)
- Chemistry Performance Test (CPT)

3.5.1 Students Attitude towards Chemistry Practical Questionnaire (SACPQ)

This was a 20 item Attitude Inventory Questionnaire adapted from Likert (1932) to determine the attitude of students towards chemistry. The development of the item focused attention on Likert 5- point rating scale. The rating of the 5-points Likert scale is as follows:

Strongly Agreed (SA)	**5**
Agreed (A)	**4**
Undecided (UD)	**3**
Disagree (D)	**2**
Strongly Disagree (SD)	**1**

Details of items contained in this instrument are presented in Appendix C

3.5.2 Skills Acquisition Observation Check List (SAOCL)

This was a 20 item Skills Acquisition Observation Check List which was adapted by the researcher from NTI, (2009) Manual to determine Skills Acquired by students' during Liquid soap production. The SAOCL is in a form of a 5- rating scale ranging from 4-0.

4= Excellent

3=Very Good

2= Good

1= Fair

0=poor

Details of items contained in this instrument are presented in Appendix B

3.5.3 Chemistry Performance Test (CPT)

This instrument was developed by the researcher. It consists of 2- sections. Section A is Bio Data (Name of College, Level, Gender, Age) and Section B consists of 50- item achievement test using content on sapornification concepts in determining the achievement of students in chemistry before and after treatment. The instrument was developed from six topics in saponification concepts (see content in Table 3.3). The distributions of chemistry performance test (CP)T item consists of 50 multiple choice objective test items each with four alternatives (A-D).

Details of items contained in this instrument are presented in Appendix A

The number of items and weight allocated to each content and taxonomy is presented in Table 3. 3

Table 3.3: Item Specification Based on Bloom's Taxonomy

Content	Know (30%)	Comp (18%)	Applic (22%)	Anal (10%)	Synt (10%)	Eval (10%)	Total (100%)
Alkanoates (esters) (14%)	3	1	2	1	1	3	11
Fats and Oils (34%)	4	5	4	2	1	4	20
Saponification (22%)	2	2	1	2	1	3	11
Preparation of Liquid soap (30%)	1	1	2	1	1	2	8
Total (100%)	10	9	9	6	4	12	50

Source: Modified blue-print from (NTI, 2009)

3.5.4 Validity of Instruments (SACPQ, SAOCL, and CPT)

The instruments were validated by three experts with minimum qualification of PhD and minimum rank of senior lecturer from the Department of Science Education, Ahmadu Bello University, Zaria. They were presented with copies of items (students' attitude towards chemistry practical questionnaire, skills acquisition observation check list and chemistry performance test) for validation. The experts were requested to:

- study the instrument and certify if the questions were considered to be testing based on the objectives of the study
- examine whether the items are clear to avoid ambiguity.

- certify if they are appropriate for the level of the students under study.
- check if the language use is at the level of the study subject.

3.5.5 Pilot Testing

The instruments were pilot tested using 30 N.C.E II students from Sa'datu Rimi College of Education kano which is part of the population but not part of the sample for the study. The purpose of the pilot test as stated by Bichi (2002), is to:

- determine the reliability of the instrument before administration,
- assess the feasibility of the study before trial,
- identify possible problems or difficulties that respondents may encounter with a view of eliminating them,
- determine the approximate time duration required for the testee to answer the test questions correctly. Each of the instrument reliability tests were carried out as follows;

3.5.5.1 Students Attitude towards Chemistry Practical Questionnaire (SACPQ)

SACPQ was administered to 30 Students of Sa'adatu Rimi College of Education kano once and split half method using odd and even number method was used to test the reliability of the SACPQ and results were analysed using kudder- Richardson (K_{12}) Statistical tool.

3.5.5.2 Skills Acquisition Observation Check List (SAOCL)

SAOCL was administered to 30 students of Sa'adatu Rimi Colleges of Education kano once and split half method using odd and even number method was used to test the reliability of the SAOCL and results were analysed using kudder- Richardson (K_{12}) Statistical tool.

3.5.5.3 Chemistry Performance Test (CPT)

CPT was administered to 30 students of Sa'adatu Rimi Colleges of Education kano. This research instrument was administered to the students at the beginning of the first week (test) and collected back for scoring. After an interval of two weeks the same instrument was re-administered to the same students (re-test). Test retest method was used to test the reliability of the instrument this is line with Tuckman, (1975) recommendation and results of the test was analysed using Pearson Product-Moment Correlation Coefficient statistical tool.

3.5.6 Reliability of the Instruments

Reliability test of the instruments were carried out as follows

3.5.6.1 Students' Attitude towards Chemistry Practical Questionnaire (SACPQ)

The reliability coefficient of SACPQ was determined using split half (odd and even number) method and results were analysed using kudder- Richardson statistical tool. From the result obtained the reliability coefficient of SACPQ was found to be 0.67. This revealed that there is strong and positive relationship between even and odd number scores in SACPQ administered to the students. Therefore, the instrument is said to be consistent and reliable for the study this is supported by Bichi, (2002) who states that a test is said to be reliable if repeated measurements using the test gives more or less the same result. Also, the length of time taken for the test was determined to be 40 minutes on the average.

3.5.6.2 Skills Acquisition Observations Check List (SAOCL)

The reliability coefficient of SAOCL was determined using split half method (odd and even number) and results were analysed using kudder- Richardson (K_{12}) statistical tool. From the result obtained the reliability coefficient of SAOCL was found to be 0.91. This revealed that there is strong and positive relationship between the even and odd

number scores in SAOCL administered to the students. Therefore, the instrument was said to be consistent and reliable for the study this is supported by Bichi, (2002) and Mohammad, (2007) who states that a test is said to be reliable if repeated measurements using the test gives more or less the same result. Also, the length of time taken for the test was determined to be 40 minutes on the average.

3.5.6.3 Chemistry Performance Test (CPT)

The reliability of CPT was determined using test re-test reliability and Pearson Product –Moment Correlation (PPMC) Statistics Method with the aid of SPSS package was used for analysis. From the result obtained the reliability of the instrument was found to be r = 0.87. This revealed that there is strong and positive relationship between the first and second CPT administered to the students. Therefore, the instrument was said to be consistent and reliable for the study, this is supported by Mohammad, (2007) who states that a test is said to be reliable if repeated measurements using the test gives more or less the same result.

3.6 Item Analysis

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

Item difficulty is determined using the relation:

P = R/T X 100

Where: p = item difficulty

R= number of candidate who got the item right

T= is the total number of candidate

Researchers such as Fraenkel and Wallen (2000), Sambo (2008), and Tuckman (1975) suggested that items with difficulty index between 40% to 60% are accepted as good item. Item below 40% are considered being too easy, and 60% being too difficult. For the purpose of this study, items with difficulty index of 25% to 75% are retained while others are modified to suit the research.

The discrimination index of test item is determined using the relation:

$$D = \frac{RU - RI}{N}$$

Where:

D =discrimination index of test item

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

RI = number of candidate that got the item correct in the lower 27% of the group

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

Sambo, (2008) suggested that items of discrimination index of 0.30- 0.90 are very good for the study, 0.30 – 0.39 are moderate, 0.20 – 0.29 are marginal items that need improvement, while items with discrimination index of 0.1- 0.19 are poor items to be discarded. Thus, in this study item between 0.30-0.70 were accepted for final selecting of CPT instrument based on recommendations made by Fraenkel and Wallen (2000), Sambo (2008), and Tuckman (1975).

3.7 Administration of Instruments

During the administration of treatment, students in the experimental group were taught concepts in saponification using practical activities while the control groups were taught using lecture method.

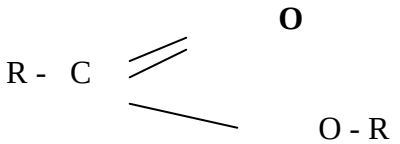
3.7.1 Administering Instruments to the Experimental Group

The students in the experimental group were taught alkanoates (esters), fats and oil, alkaline hydrolysis of fats and oil and liquid soap production using practical activities. Alkanoates (esters) was presented as Lesson -1 and was taught in the first week for 2 - hours, Fat was presented as Lesson -2 and was taught in the second week for 2 - hours, oil was presented as Lesson -3 and was taught in the third week for 2 – hours, laboratory preparation of soap was presented as Lesson -4 and was taught in the fourth week for 2 - hours, laboratory preparation of detergent was presented as Lesson – 5 and was taught in the fifth week for 2 - hours, liquid soap production was presented as Lesson – 6 and was taught in the sixth week for 2 - hours according to the following steps:

Step 1: Teacher introduces the lesson by telling students' the purpose of the lesson and students write the general molecular and structural formula of alkanoates

Students Activities:

- Write the general molecular and structural formula of alkanoates
- Molecular formulae of alkanoates is RCOOR
- Structural formulae of alkanoates



Where R could be hydrogen or an alkyl group and R is an alkyl group, R and R' may be the same or different.

Step 2: students carry out laboratory preparation of ethyletheanoate

Students' Activities:

Label 3- test-tube as test- tube a, b, and c

i. Weigh about 3.00g of Shea butter into a test-tube observe carefully

ii. Measure $6cm^3$ of ethanol

iii. Measure $6cm^3$ ethanoic acid

iv. Measure 1 cm^3 of conc H_2SO_4 into test-tube (c)

Procedure:

Measure $2cm^3$ of ethanol into test-tube (a) and $2cm^3$ of ethanoic acid into test-tube (b), mix the two solution in a clean- dry into test-tube (c) then add few drops of conc H_2SO_4. Reflux for 5-10 minutes. Add little of the product into water. Record the observation that occur in test-tube (3)

Test	Observation	Inference
(a) $2cm^3$ of ethanol + $2cm^3$ of ethanoic acid + 1-2 drops of conc H_2SO_4 + Reflux for 5-10 minutes	Sweet fruity smell was perceived	Presence of ester
(b) mixture from (a) above + water	Slightly soluble in water	Ether is present

Equation for the reaction: $CH_3CH_2OH + CH_3COOH_{(aq)} \underset{}{\overset{H^+}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$

Ethanol ethanoic acid ethyl ethanoate water

The Conc H_2SO_4 act as a dehydrating agent in the above experiment

Step 3: Students carry out laboratory experiment to determine the boiling point of ethyl ethanoate

Students' Activities:

i. Half fill a $50cm^3$ beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Attach a boiling point tube to a thermometer and insert both into beaker containing oil (oil bath) ethyl ethanoate

iii. Place about 1ml of the ester in the boiling tube

iv. Put 2-3 piece of broken porcelain to act as anti-bumbling granules

iv. Heat the beaker containing liquid paraffin gently using a bunsen-burner flame and stir the hot oil bath gently to obtain homogeneous heating.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

The boiling point of ethylethanoate is 170^0C

Step 4: Students carry out Acid and Base catalyzed hydrolysis of ethylethanoate to determine its chemical properties.

Students' Activities: Students carries out acid catalyzed hydrolysis;

i. Measure $2cm^3$ of ethylethanoate into a test-tube

ii. Measure $2cm^3$ of dil H_2SO_4 into a test-tube

Procedure:

Add $2cm^3$ of ethylethanoate to $2cm^3$ of conc H_2SO_4 and heat gently in a water bath. Record your test observation and infer in the plain sheet provided. Write the equation for the reaction.

Test	**Observation**	**Inference**
$2cm^3$ of ethylethanoate + $2cm^3$ of ethanoic acid + Heat	Sweet fruity smell was perceived	Presence of ether

Equation for the reaction:

$CH_3COOCH_2CH_3 + H\text{-}O\text{-}H \longrightarrow CH_3CH_2OH + CH_3COOH_{(aq)}$

ethyl ethanoate water Ethanol ethanoic acid

Students carry out base catalysed hydrolysis as follows:

i. Measure $2cm^3$ of ethylethanoate into a test-tube

ii. Measure $2cm^3$ of aqueous NaOH into a test-tube

Procedure: to about 2 cm^3 of ethylethanoate add $0.2cm^3$ of aqueous NaOH and heat gently for 1hour. Record your test observation and infer in the plain sheet provided. Write the equation for the reaction.

Test	**Observation**	**Inference**
$2cm^3$ of ethylethanoate + $0.2cm^3$ of aqueous NaOH + Heat	Sweet fruity smell was perceived	Presence of ether

Equation for the reaction:

$$CH_3COOC_2H_5(l) + NaOH(aq) \longrightarrow CH_3OONa(aq) + C_2H_5OH(aq)$$

Step 5: Teacher states the uses of Ethyl Ethyl ethanoates

Uses of Ethylethanoates

It is used as solvent for paints and vanishes, to hasten drying.

It is used in making perfumes and cosmetics and as artificial flavoring for foods.

Evaluation: The teacher evaluates the students learning out come by asking students questions based on what they learnt during the lesson.

Questions:

1. Write the structural formulae of Alkanoate.
2. Carry out laboratory preparation of Alkanoates (Ethylethanoate).
3. State 2 physical properties of Alkanoates (Ethylethanoates).

Carry out Laboratory experiments to determine the chemical properties of Ethyl Ethanoates.

State the uses of alkanoates.

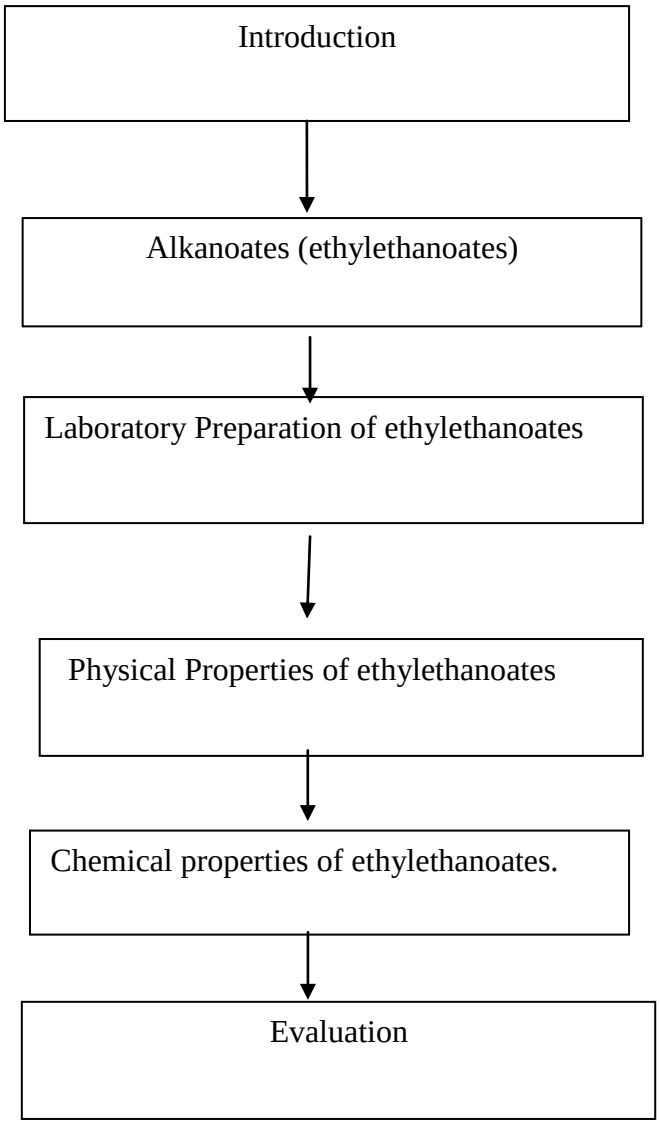


Fig.3.2: Flow Chart Showing Step by Step Presentation of Concepts in Saponification

Source: (Mohammed 2007)

3.7.2 Teaching the Control Group

Students in the control group were taught alkanoates (esters), fats and oil, alkaline hydrolysis of fats and oil and liquid soap production using practical activities. Alkanoates (esters) was presented as Lesson -1 and was taught in the first week for 2 - hours, Fat was presented as Lesson -2 and was taught in the second week for 2 - hours, oil was presented as Lesson -3 and was taught in the third week for 2 – hours, laboratory preparation of soap was presented as Lesson -4 and was taught in the fourth week for 2 - hours,

laboratory preparation of detergent was presented as Lesson – 5 and was taught in the fifth week for 2 - hours, liquid soap production was presented as Lesson – 6 and was taught in the sixth week for 2 - hours according to the following steps:

Step 1: The teacher introduced the lesson by telling the students the purpose of the Lesson

Step 2: Teacher identifies apparatus require for the laboratory preparation of Alkanoates (Ethyl Ethanoate) i.e. ethanol, glacial ethanoic acid and conc H_2SO_4

Step3: Teacher carries out laboratory preparation of alkanoates.

Step 4: Teacher identifies the physical properties of alkanoates.

Step 5: Teacher carry out laboratory experiments to determine chemical properties of alkanoates (acid and base hydrolysis of ethylethanoate).

Step 6: Teacher evaluates the students learning out come by asking the students questions based on what they learn during the lesson.

3.8 Procedure for Data Analysis

SACPQ and SAOCL were administered before treatment as pretest. The teaching last for a period of six weeks and 2-hours interaction for each lesson with the help of research assistants after which, SACPQ, SAOCL and CPT were re-administered to the students as posttest. The SAOCL was administered and scored at the point when the students were been asked to produce liquid soap while CAT and SACPQ were administered after the lesson. The scores for each instrument used were collected, scored and rewarded based on experimental and control groups as well as attitude, skills acquisition and performance in chemistry.

3.9 Data Analysis

The data collected for these studies were analysed and used in answering research questions and hypothesis as follows.

3.9.1 Answering Research Questions

The data collected for this study was analysed and used for answering research questions as follows;

Research Question One: What is the difference between the attitudinal change of N.C.E chemistry students exposed to practical activities and those taught using lecture method?

Mean Rank and Mean Rank Difference of pre and post attitude scores of students in experimental and control groups was used in answering this research question.

Research Question Two: What is the difference between the skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method?

Mean Rank and Mean Rank Difference of pre and post test skills acquisition scores of students in experimental and control groups was used in answering this research question.

Research Question Three: What is the difference between performance in chemistry of students' exposed to practical activities and those taught using lecture method?

Mean and standard deviation of post test chemistry performance test of students in experimental and control groups was used in answering this research question.

3.9.2 Hypotheses Testing

The data collected in this study was also used to verify the formulated hypotheses at $p \leq 0.05$ level of significance as follows:

Ho_1: There is no significant difference between attitudinal change of N.C.E chemistry students exposed to practical activities and those taught using lecture method.

This hypothesis was analysed using Krukal-wallis H- test.

Ho_2: There is no significant difference between skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method.

This hypothesis was analysed using Kruskal-Wallis H- test.

H_{O3}: There is no significant difference between performance of N.C.E chemistry students exposed to practical activities in chemistry and those taught using lecture method.

This hypothesis was analysed using t-test statistic.

However, the researcher used a statistical package called Statistic Package for Social Sciences (SPSS) for analysis.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION OF RESULTS AND DISCUSSIONS

4.1 Introduction

This study investigated the impact of practical activities on attitude, skills acquisition and performance in chemistry among colleges of education students in north- west zone Nigeria. This chapter is presented under the following sub-headings:

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

4.2 Data Analysis and Presentation of Results

The data collected for the purpose of this study were analysed based on the research questions and hypothesis formulated which are as follows:

Research Question One: What is the difference between the attitudinal change of N.C.E chemistry students exposed to practical activities and those taught using lecture method?

To answer this research question, the data collected from students attitude towards chemistry practical questionnaire were scored and analysed using mean rank and mean rank difference of pre and post attitude test score of students in experimental and control groups. This is shown in Table 4.1

Table 4.1: Result of Mean Rank and Mean Rank Difference of Attitude Scores of Students in Experimental and Control Groups Before and After Exposure to Treatment

Groups		N	Mean Rank	Mean Rank Diff
Experimental	Before	30	15.70	0.20
Control		30	15.50	
Experimental	After	30	45.70	30.00
Control		30	15.50	

Results in Table 4.1 shows that before treatment, students in the experimental group had a mean rank score of 15.70 while those in control group had a mean rank score of 15.50 with a mean rank difference of 0.20. This shows that there is no much difference in attitude of students in both groups. After treatment, the Mean rank scores of students in the experimental group were 45.70 and 15.50 for students in the control groups with a mean rank difference of 30.00. This shows that students in the experimental group developed positive attitude towards chemistry after been exposed to practical activities than students in the control group who were taught using lecture method.

Research Question Two: What is the difference between the skill acquired by N.C.E chemistry students exposed to practical activities when teaching chemistry concepts and those taught using lecture method?

Data collected from skills acquisition scores were analysed using mean rank and mean rank difference of both pre and post test scores of students in experimental and control groups to answer this research question. This is shown in Table 4.2

Table 4.2: Results of Mean Rank and Mean Rank Difference Skills Acquisition Scores of Students in Experimental and Control Groups Before and after exposure to Treatment

Group		N	Mean Rank	Mean Rank Diff
Experimental	**Before**	30	20.92	0.77
Control		30	20.15	
Experimental	**After**	30	100.50	60.07
Control		30	40.43	

Results in Table 4.2 shows that students in the experimental group had a mean rank score of 20.92 and those in the control groups had a mean rank score of 20.15 with mean rank difference of 0.77 before treatment. It can be seen that there is no much difference between skills acquisition of student in the experimental group and those in the control group before exposure to treatment. After treatment, the mean rank score of 100.50 was recorded for students in the experimental group and 40.43 for students in the control groups with a mean rank difference of 60.07. This shows that students in the experimental group acquired more skills after been exposed to practical activities than students in the control group who were taught using lecture method.

Research Question Three: What is the difference between performance in chemistry of students exposed to practical activities when teaching chemistry concepts and those taught using lecture method?

The data collected for answering this research question were analysed using Mean and Standard Deviation of post test performance test of students in experimental and control groups. This is shown in Table 4.3

Table 4.3: Mean and Standard Deviation of Chemistry Performance Test Scores of Experimental and Control Groups after Treatment

Group	N	Mean	SD	Mean Diff
Experimental	30	40.57	5.81	11.70
Control	30	28.87	5.56	

Results in Table 4.3 revealed that the experimental group means score of 40.57 is higher than 28.87 for the control group with a mean difference of 11.70. This means that students in the experimental group performed better than those in the control group. This means exposing students to practical activities when teaching saponification concepts enhances performance in chemistry concepts.

Hypothesis One: There is no significant Attitudinal Change towards chemistry among N.C.E chemistry students exposed to practical activities and those taught using lecture method.

To test this research hypothesis pre and post test Scores from Attitude towards Chemistry Practical Questionnaire were analysed using Kruskal- Wallis Test as shown in Table 4.4

Table 4.4a: Results of Kruskal - Walis Test Scores from Attitude towards Chemistry Practical Scores in Experimental and Control Groups Before and After Treatment

	Group	N	Mean Rank	Mean Rank Diff	H-Cal	df	P	Remarks
Attitude Before	Experimental	30	75.30	39.32	101.55	3	0.01	S
	Control	30	35.98					
Attitude Aftrer	Experimental	30	105.50	80.28				
	Control	30	25.22					

Significant at $p \leq 0.05$ level of significance.

Results in Table 4.4a revealed that there is a significant difference in the attitudinal change towards chemistry among students in the experimental group since the

p value calculated is 0.01 less than 0.05 level of significance set for the purpose of this study but did not show where the significant differences occur. Therefore, Tukey HSD test was carried out to verify where the significant difference exists. This is shown in Table 4.4b.

Table 4.4b: Results of Tukey HSD Test Analysis of Students Attitude toward Chemistry Practical Scores of Experimental and Control Groups Before and After Treatment

Group	Group		Mean Difference	Std. Error	p	Remarks
Experimental (Before)	Control	Before	13.67	1.08	0.01	S
	Experimental	After	41.10	1.08	0.01	S
	Control	After	16.23	1.08	0.01	S
	Experimental	Before	13.67	1.08	0.01	S
Control (Before)	Experimental	After	54.77	1.08	0.00	S
	Control	After	2.57	1.08	0.09	NS
	Experimental	Before	41.10	1.08	0.01	S

Significant at $p \leq 0.05$ level of significance.

Results in Table 4.4b revealed that p value of 0.09 was recorded for students in the control group before and after treatment which is greater than 0.05 level of significance set for the study. This shows that there is no significant difference between the attitude of student in the control group before and after treatment. Before treatment result of the experimental and control groups indicates that there is significant difference between the skills acquired by N.C.E chemistry students exposed to practical activities and those not exposed because the p value calculated was 0.01 which is less than 0.05 level of significant set for this study. After treatment Mean rank score of 105.50 for experimental group and 25.22 for control group with mean rank difference of 80.22 and p value 0.01 less than 0.05 level of significance was recorded. Mean rank difference of

80.22 shows that student in the experimental group develop positive attitude towards chemistry than those in the control group. Therefore, the research hypothesis which stated that there is no significant attitudinal change towards chemistry among N.C.E chemistry students exposed to practical activities and those taught using lecture method was here by rejected.

Hypothesis Two: There is no significant difference in the skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method.

This hypothesis was tested using scores collected from skills acquisition observation check list which was administered before and after administration of treatment. Results were analysed using Kruska-Wallis Test at $p \leq 0.05$- level of significance. This is shown in Table 4.5

Table 4.5a: Results of Kruskal- Wallis Analysis of Skills Acquisition Scores of Experimental and Control Groups Before and After Treatment

Group		N	Mean Rank	Mean Rank Diff	Df	H- cal	P	Remarks
Experimental	Before	30	20.92					
				79.58				
	After	30	100.50		3	103.76	0.01	S
Control	Before	30	20.15					
				20.28				
	After	30	40.43					

Significant at $p \leq 0.05$ level of significance

The Krukakal-Wallis test result in Table 4.5a revealed that there is a significant difference in the skills acquisition of N.C.E chemistry students expose to practical activities and those taught using lecture method. This is because the calculated P value 0.01 is less than 0.05 level of significance set for the purpose of this study, but did not show where the difference exists. Therefore, Tukey HSD test was carried out to verify where the difference exists. This is shown in Table 4.5b

Table 4.5b: Results of Tukey HSD Test Analysis of Skills Acquisition Scores of Students in Experimental and Control Groups Before and After Treatment.

Groups	Group		Mean Difference	Std. Error	P	Remarks
Experimental	Control	Before	4.87	0.82	0.01	S
(Before)	Experimental	After	58.93	0.82	0.01	S
	Control	After	9.27	0.82	0.01	S
	Experimental	Before	4.87	0.82	0.01	S
Control(Before)	Experimental	After	63.80	0.82	0.01	S
	Control	After	14.13	0.82	0.01	
	Experimental	Before	58.93	0.82	0.01	S

Significant at $p \leq 0.05$ level of significance.

Tukey HSD results in Table 4.5b revealed that before treatment result of students in the experimental and control groups indicated that there is significant difference between the skills acquired by N.C.E chemistry students exposed to practical activities and those not exposed because the p value calculated is 0.01 less than 0.05 level of significant set for this study. After treatment mean rank score of 100.50 for students in the experimental group and 40.43 for students in the control group and p value 0.01 less than 0.05 level of significant was recorded. Mean rank difference of 60.07 shows that student in the experimental group acquire more skills than those in the control group after treatment.

Research Hypothesis Three: There is no significant difference between the performance of N.C.E chemistry students exposed to practical activities in chemistry and those taught using lecture method.

To test this hypothesis scores from posttest chemistry performance test of both experimental and control groups were collected and analysed using t- test statistic at p≤ 0.05- level of significance. This is shown in Table 4.6

Table 4.6: Results of t-test Analysis of Scores from Chemistry Performance Test of Students in Experimental and Control Groups

Group	N	Mean	SD	t-cal	Df	p	Remarks
Experimental	30	40.57	5.81	7.97	58.00	0.01	S
Control	30	28.87	5.56				

Significant at p≤ 0.05 level of significance

Result in Table 4.6 revealed that t- value calculated was 7.97; Df was 58.00 and p value of 0.01 which is less than 0.05 level of significance set for the study was recorded. This means that students in the experimental group achieve more than those in the control group because significant difference exists between performance in chemistry of N.C.E students exposed to practical activities and those who were not exposed, the null hypothesis which stated that there is no significant difference is therefore rejected. This shows that exposing students to practical activities when teaching chemistry concepts enhances students' performance in chemistry better than those taught using lecture method. This was also confirmed in the mean score values which is 40.57 for experimental group higher than 28.87 of control group.

4.3 Summary of Findings

After carrying out statistical analysis of data collected during the cause of this study, the finding were summarised as follows;

- There is significant attitudinal change towards chemistry concepts between N.C.E chemistry students' exposed to practical activities and those taught using lecture method.

- There is a significant difference in the skills acquired by N.C.E chemistry students exposed to practical activities and those taught using lecture method. This finding answered stated research question two and verified formulated hypothesis two.
- There is a significant difference between the performance of N.C.E chemistry students exposed to practical activities and those who were taught using lecture method. This finding answered stated research question three and verified formulated hypothesis three.

4.4 Discussion of Results

Results from Tables 4.1, 4.4a and b revealed that there is significant attitudinal change towards chemistry between students in the experimental group and those in the control group after treatment. The results are in agreement with the work of different scholars such as (Berg (2005), Thompson & Soyibo,(2002) Jaynes, (2005), Hofstein & Lunetta, (2004), Brodie, (2001) & Williams, (2004)) who were of the view that practical activities give students a more coherent understanding of theory connected to the laboratory activities, is an important medium for enhancing attitudes and that the laboratory as a unique social setting, has (when activities are organized effectively) great potential in enhancing social interactions that can contribute positively to developing attitudes.

The research work carried out above revealed that when chemistry concepts are taught using practical activities it brings about positive attitude towards learning chemistry concepts.

Results in Tables 4.2 , 4.5a and b showed that there is a significant difference between the skills acquired by N.C.E chemistry students exposed to practical activities when teaching chemistry concepts and those who were taught using lecture method which are in agreement with the work of (Lagowski 2002, Carnduff & Reid 2003,Ravishankar

& Ladge 2009) who were of the view that Chemistry practical classes help students understand theories and chemical principles which are difficult or abstract, they offer opportunity to handle chemicals safely; gain hands- on experience in using instruments and apparatus, develop scientific practical skills and enthusiasm to chemistry, develop basic manipulative and problem solving skills, gain opportunities to students and investigators of the experimental work, identify chemical hazards and learn to assess and control risks associated to chemicals.

The results of studies carried out by Yadav and Mishra, (2013) revealed that the achievement of the students who were taught using the laboratory approach was significantly higher than those who were taught using the traditional approach and the development of process skills were higher in the students who were taught using the laboratory approach.

Chebii, Wachanga and Kiboss, (2013) investigated the effectiveness of science process skills mastery learning approach on students' acquisition of practical skills and were of the view that students in the experimental group outperform students in the control group in the acquisition of some selected chemistry practical skills.

This shows that teaching chemistry concepts using practical activities leads to acquisition of skills.

Result in Table 4.3, 4.6a and b revealed that there is a significant difference between performances in chemistry means scores of students in the experimental and control groups in the study. This significant difference was in favour of the experimental group who were exposed to practical activities. The findings in this study are in line with those of some past studies who were of the view that, when chemistry concepts are taught using practical activities it enhances students' performance. Such study includes that of Usmani, (2011) who opines that students with practical experience are more likely to

perform well than those with limited practical skills. Yalwa, (2008) who was of the view that chemistry is a subject that cannot be by mere reading, verbal explanation and imaginations but by involving practice in all topics. Also, Ibe and Nwosu (2003) stated that theoretical chemist would be less important than the practical chemist, since theory is often superseded with facts. Omwirheren, (2009) reported that students encounter problems in chemistry in respective of their ability and mode of instruction and therefore, called for proper theoretical orientation with activities based instruction(practical activities) so as to enhance students performance in chemistry.

Nzewi, (2008) was of the view that practical activities can be regarded as a strategy that could be adopted to make the task of teaching more real to students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters which enhances students' performance.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the objectives of the study, methodology employed to collect data and summary of the findings were briefly highlighted. The conclusions emanating from the findings and requisite recommendations were outlined. The chapter is presented according to the following sub-headings:

- Summary
- Conclusion
- Contribution to Knowledge
- Recommendations
- Limitation of the Study
- Suggestion for further Studies

5.2 Summary of the Study

This study examined the impact of practical activities on attitude, skills acquisition and performance in chemistry among colleges of education students in north-west zone Nigeria. . During the course of this study students in the experimental group were exposed to practical activities while those in the control group were exposed to lecture method for a period of six weeks.

The target population for the study was 1,982 N.C.E II chemistry colleges of education students in north-west zone Nigeria. A sample of 60 students were randomly selected using balloting method from two colleges of education in Kaduna and Katsina states and grouped into control and experimental using simple random sampling technique.

Three research instruments i.e students attitude toward chemistry practical questionnaire (SACPQ) with reliability coefficient of 0.67, skills acquisition observation check list (SAOCL) with reliability coefficient of 0.91 and chemistry performance test (CPT) with reliability coefficient of 0.87, were used to collect data for the study. The instruments were validated by experts who are senior lecturers and above with a minimum qualification of PhD from Science Education Department, Faculty of Education Ahmadu Bello University Zaria. Three research questions were stated and three research hypotheses were formulated. The data collected were subjected to statistical analysis at 0.05 level of significance. Kruskal-Wallis H- Test was used to test hypothesis on attitude and skills acquisition while T-test statistical tool was used to test hypothesis on performance in chemistry.

5.3 Summary of Major Findings

1. There is significant attitudinal change towards chemistry among students exposed to practical activities compared to that of their counterparts who were taught using lecture method.
2. The subjects exposed to practical activities acquire more skills in chemistry concepts than their counterparts who were taught using lecture method.
3. The performance of students exposed to practical activities when teaching saponification concepts was significantly higher than that of their counterparts who were taught using lecture method.

5.4 Conclusions

From the findings in this study, the following conclusions were drawn: Exposing N.C.E students to practical activities when teaching chemistry concepts;

1. enabled students to develop positive attitude towards chemistry subjects.
2. enabled them acquire skills require to impact knowledge to learners after training.
3. enhanced students' performance in chemistry.

5.5 Contribution to Knowledge

This study established that:

1. The chemistry performance test which was designed by the researcher to determine the impact of practical activities on performance in chemistry among colleges of education students was validated, found reliable and new can be adopted by other researchers for further studies.
2. Skills acquisition observation check list which was adapted by the researcher was found reliable and effective. Which other researchers can adopt for further studies.
3. The findings in the study add new information to the existing literature which other researchers could cite.

5.6 Recommendation

Based on the findings from this research the following recommendations were made:

1. Results from this study revealed that exposing colleges of education students to practical activities when teaching chemistry concepts enable them develop positive attitude towards chemistry, acquire skills require to impact knowledge to learners after training and enhances their performance in chemistry. Therefore, colleges of education teachers should be encouraged to expose their students to

practical activities when teaching chemistry concepts by allowing them to perform the practical themselves.

2. N.C.E chemistry students should be allowed to take part in all activities in the laboratory during the practical activities while teacher and laboratory technologist guide them.
3. The N.C.C.E curriculum should be revised so as to make provision for practical activities for each course for the purpose of incorporating skills acquisition.
4. The government should provide practical apparatus, reagents for effective practical activities.
5. STAN should organize Workshops, Seminars and Conferences on how to effectively use practical activities to teach chemistry concepts in recognition to skills acquisition.

5.7 Limitations of the Study

The study has some limitations which are:

- The researcher found it difficult to stick to time because students were always busy with their lectures.
- Students' negative attitude towards chemistry and the importance of research served as constrain during the study.

5.8 Suggestions for Further Studies

The following Suggestions are made to expand the scope of this study:

1. A similar study should be carried out focusing the teaching of chemistry concepts in other teacher training institutions using practical activities to find out if similar or different results as in this study will be obtained.
2. There is a need to carry out similar studies in other parts of Nigeria to make wider generalization.

3. Similar studies should be carried out in other science subjects such as Biology, Physics, Agricultural Science, Basic Science and Technology, Computer Science, Geography, etc both at primary, Secondary and tertiary institutions to find out if similar or different results as in this study will be obtained.

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APPENDICES

APPENDIX A

STUDENTS' ATTITUDE TOWARDS CHEMISTRY PRACTICALS QUESTIONNAIRE (ATCQ)

Dear Respondent,

Below is a list of items designated by a Master's student to examine the degree of students' attitude towards Chemistry. You are requested to freely rate yourself on the items. Be informed that information provided was used strictly for this research only and was treated confidentiality.

SECTION A: BIODATA

Name of College……..

Level……..

Gender: Male [ ] Female [ ]

Age……..

SECTION B:

ITEMS ON ATTITUDE TOWARDS CHEMISTRY PRACTICALS

S/N	ITEM	SA	A	N	SD	D
1	I like Chemistry practical.					
2	Chemistry help in developing skills					
3	Chemistry practical classes are not safe.					
4	Chemistry practical classes help me know the importance of chemistry to everyday life.					
5	When theories are related to practical activities, it makes me see chemistry as real not abstract					
6	When I am working in the chemistry laboratory, I feel I am doing something important					
7	I remember chemistry concepts better by doing it in the laboratory rather than just reading it in a book.					
8	Chemistry practical classes are time consuming					
9	During practical classes, I find out that most of the chemicals and reagents use in chemistry are locally available					
10	During chemistry practical classes i get to identify and learn how to manipulate different scientific equipment.					
11	Carrying out chemistry experiment makes me believe that content of chemistry courses is not applicable to daily life.					
12	I feel anxious when attending chemistry practical classes					
13	Chemistry makes our life more difficult					
14	I get to explore more and also learn new skills from chemistry practical.					
15	I understand chemistry concepts more by doing it practically rather than just hearing about it					
16	I see chemistry as an abstract subject.					
17	The practical experiments carried out in this lesson were not related to theories.					
18	Carrying out chemistry practical is not interesting					
19	Doing chemistry experiments in school is boring					
20	I can see what happens during practical chemistry classes which makes me understand chemistry better rather than when someone tells me about it.					

APPENDIX B

Skills Acquisition Observation Check List (SAOCL)

Below is a list of items in an Observation check List which was developed and designated by a Master's student to check Skills Acquired by Students during the production of Liquid soap. The purpose of this research instrument is to investigate the influence of practical activities in Chemistry on Skills Acquisition. It was use by the researcher and the research assistant. Thank you Hadiza MUHAMMAD-LAWAL.

Instruction: please kindly observe the students and score appropriately.

		SCORES				
S/N	**ITEM**	**4**	**3**	**2**	**1**	**0**
1	Washing and draining of equipments used					
2	Appropriate manipulation of equipments					
3	Correct identification of reagents					
4	Accurate weighing of reagents					
5	Proper Dilution.					
6	Orderly addition of reagents					
7	Appropriate mixing of reagents					
8	Appropriate reading of hydrometer					
9	Following appropriate procedure during the production process.					
10	Proper preparation of solutions					
11	Identifying the importance of each reagent used during the production of soap.					
12	Regular stirring techniques					
13	Allowing solution to stay for recommended period					
14	Recording correct observations					
15	Making accurate inference					
16	Mixing in the correct direction					
17	Accurate measurement using measuring Cylinder					
18	Time management					
19	Safety precautions					
20	Accurate result					

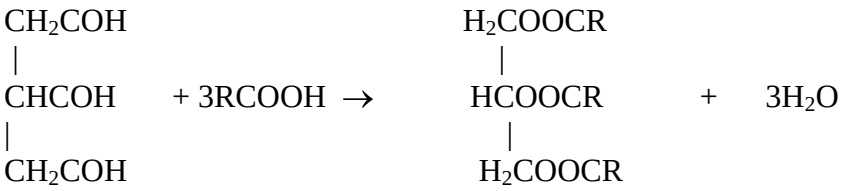
4=Excellent
3=very Good
2=Good
1=Fair
0=Poor

APPENDIX C

Chemistry Performance Test

INSTRUCTION: Tick the Correct Option **Duration: 40 minutes**

Q1. What process is involved in the reaction represented by the equation below?



(A) Saponification.
(B) Esterification
(C) Fermentation
(D) Dehydration.

Q2. Which of the following statements about soapless detergents is correct? They

(A) Lather readily with water.

(B) Increase the surface tension of water.

(C) Cause hydrolysis of salts in water.

(D) Form a curd precipitate with soft water.

Q3. What is the product of the reaction between C_2H_5OH and excess acidified $K_2Cr_2O_7$?

(A). CH_3COOH.

(B). $C_2H_5OC_2H_5$.

(C) $HCOOCH_3$.

(D) C_2H_5CHO.

Q4. The major product formed by the reaction between ethanoic acid and aqueous sodium hydroxide is _____

(A). Soap.

(B). Sodium ethanoate.

(C). Sodiummethoxide.

(D). Water.

Q5. Which of the following statements is not correct about esterification?

(A). It is a slow reaction.

(B). The process is reversible.

(C). It is similar to hydrolysis.

(D). It is catalysed by acids

Q6. The following statements are facts about oils except

(A). Oils are liquids at room temperature

(B). Their triglycerides contains more saturated fatty acids(palmitic and stearic acids) than the unsaturated oleic acid.

(C).Their triglycerides contains more unsaturated fatty acids (palmitic and stearic acids) than the saturated oleic acid.

(D). they are liquids usually of plants origin.

Q7. Soap does not cause water pollution because:

(A) It is biodegradable

(B) It form scum in hard water

(C) It reacts with hydrogen ions in acidic water.

(D) It does not react with hydrogen ions in acidic water.

Q8. Which type of fatty acid is present in olive oil?

(A) Oleic Acid

(B) Stearic Acid

(C) Follic Ac id

(D) Hydrochloric Acid

Q9. When soaps are dissolved in hard water they contains dissolved salts of the following metals except

(A). Calcium

(B). Magnesium.

(C). Iron (II)

(D). Zinc

Q10. Ethylethanoate can be presented as _____

(A) $CH_3\ CH_2\ CO_2\ CH_3$

(B) $(CH_3CO_2)O$

(C) $CH_3\ CH_2\ CO_2\ CH_2\ CH_3$

(D) $CH_3\ CO_2\ CH_2\ CH_3$

Q11. Detergents have the general formulae _____

(A) $R\ (CH_2)_n\ OH$

(B) $R\ SO_3^-\ Na^+$

(C) $R\ C0^-_2\ Na^+$

(D) $R\ CO_2H$

Q.12 The Alkaline hydrolysis of fats and oils produces soap and _____

(A) Propane -1,1,3 – triol

(B) Propne – 1,3,3 – triol

(C) Propane -1,2,2 – triol

(D) Propane – 1,2,3 – triol

Q13 Which of the following best describes Saponification reaction?

(A) Reaction of Carboxylic acids with sodium hydroxide

(B) Reaction of Alkanoates with acid

(C) Reaction of Carboxylic acids with Alcohols

(D) Reaction of Alkanoates with sodium hydroxide

Q14. The general formulae of Alkanoates is

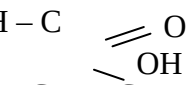
(A) RCHO

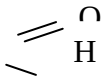
(B) R_2CO

(C) RCOOH

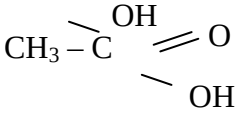
(D) RCOOR

Q15. The structural formulae of ethnanoic acid is

(A) 

(B) 

(C) 

(D) 

Q16. Which of the following processes takes place during the production of margarine from vegetable oil?

(A) Esterification

(B). Hydrolysis

(C). Hydrogenation

(D). Saponification.

Q.17 Detergents are manufactured with straight chain hydrocarbons so as to make them

(A). Cheaper.

(B). Foamy.

(C). Biodegradable.

(D) Soluble

Q.18 Oil can be changed in to fat through the process of:

(A). Alkylation.

(B). Substitution.

(C). Hydrogenation.

(D). polymerization.

Q.19 Which of the following products are formed during the combustion of fats and oils?

(A). Carbon(iv)oxide and water

(B). Margarine and Hydrogen

(C).Ethyl Ethanoates and Soap

(D).Soaps and Detergents

Q20. The presence of _____ is responsible for the solubility of soap in water.

(A) Alkyl.

(B). Carboxylic

(C). Etylethanoates

(D). Sodium

Q21. The function of H_2SO_4 in esterification of ethanoic acid with ethanol is to

(A) Serve as a dehydrating agent

(B) Serve as a Solvent

(C) Act as a Catalyst

(D) Prevent any side reaction.

Q22. The bye product of the reaction between fats / oils with caustic soda is:

(A) Soap

(B) Propan-1,2,3-triol

(C) Ethyl Ethanoates

(D) Water

Q23. Oils belong to ——— group of organic Compounds:

(A) Carbonyl Group

(B) Amino Group

(C) Carboxylate Group

(D) Hydroxyl Group

Q.24 $CH_3COOH + C_2H_5OH \xrightarrow[H_2SO_4]{} CH_3COOC_2H_5 + H_2O$

The reaction above is best described as:

(A) Esterification

(B) Condensation

(C) Saponsification

(D) Neutralization

Q25. Pure Fats and Oils are Colourless due to the presence of:

(A). Fatty Substances

(B). Alcohols

(C). Non Fatty Substances

(D). Alkyl

Q26. The reaction of vegetable oil with a solution of wood ash is an example of:

(A). Saponification Reaction

(B). Neutralization Reaction

(C). Hydrogenation Reaction

(D). Esterification Reaction

Q27. What are the major products formed when C_2H_5OH reacts with CH_3COOH?

(A). $C_2H_5COOH_3$.

(B). CO_2.

(C). $CH_3COOC_2H_5$.

(D). C_3H_7COOH.

Q28. Fats and oils are used as raw materials in the following industries except:

(A). paint industry.

(B). Plastic industry.

(C). Margarine Industry.

(D). Cosmetics Industry.

Q29. Locally produced soap in which wood ash is used as the base is usually soft because the wood ash contains a lot of :

(A). Sodium ion.

(B). Potassium ion.

(C). Lithium ion.

(D). Calcium ion

Q30. Esterification of 1,2,3-triol and unsaturated higher carboxylic acid will produce:

(A). Fats.

(B). Soap.

(C). Methylpropanoate.

(D). Oils

Q31. Which of the following solvents is not suitable for fats?

(A). Benzene.

(B). Ethoxyethane.

(C) Tetrachloromethane.

(D) Water

Q.32 Fats and oil can be tested using:

(A). Iodine.

(B). Sudan (iii) Reagent

(C). Millon Reagent

(D). Lime water

33.The process of soaking antisal in liquid soap production for 2 – 3 days with regular stirring is to _____:

(A) Get a smooth product

(B) Make sure the antisal dissolve totally

(C) Thicken the liquid soap

(D) Give the liquid soap a good look

Q.34 In the production of soap, concentrated sodium chloride solution is added in other to:

(A). Increase the solubility of the Soap

(B). Decrease the solubility of the Soap

(C). Saponify the soap

(D). Emulsify the Soap

Q.35 The following reagents are use during the production of liquid soap except:

(A) Soda Ash

(B) Caustic Soda

(C) Tetraoxosulphate (vi) Acid

(D) Alkyl benzene sulphonic Acid.

Q36. Fats are classified as:

(A). Hydrocarbons.

(B). Alkanoates.

(C). Alkanols.

(D). Carbohydrates.

Q.37 Fats are solids, usually of:

(A). Animal origin

(B). Plant origin

(C). Soli origin

(D). Petroleum origin

Q38. When dealing with reagents/chemicals and apparatus in the laboratory, it is advice to:

(A). Stick to all laboratory precaution and safety process

(B). Not to adhere to all laboratory precaution and safety

(C). Do thing haphazardly in the laboratory

(D). Not to place reagents/ chemicals and apparatus in their normal places.

Q39. When Sodiumethanoate is treated with a few drops of concentrated tetraoxosulphate (VI) Acid, one of the products formed is:

(A) CH_3COOH

(B) CH_3COOCH_3

(C) $CH_3COOC_2H_5$

(D) CH_3COOCH_3

Q40. Which of the following compounds is a soap less detergent?

(A). $C_{12}H_{25}OSO_3Na$.

(B). $C_{17}H_{35}COONa$.

(C). C_6H_5OH.

(D). $C_4H_9COOC_2H_5$.

Q41. During the preparation of detergents from fatty acids the following procedures are followed except:

(A). Fatty acids are reduced to fatty ethanol (alcohol) by the action of sodium in ethanol

(B). The alcohol is treated with conc H_2SO_4 to give alkyl hydrogen tetraoxo sulphate(iv)acid

(C). Alkyl hydrogentetraoxosulphate(iv)acid is treated with sodium hydroxide or potassium hydroxide

(D). Fats or oils are hydrolysed using either sodium hydroxide solution or potassium hydroxide solution to form sodium salts of fatty acids.

Q.42 Soda ash is used in liquid soap production so as to:

(A) Aid foaming

(B). Regulate caustic soda

(C). Act as a cleaning agent

(D).Increase the volume of the liquid soap

Q43. An advantage of detergent over soap is that detergents are

(A). Readily available.

(B). In powdered form.

(C). Non-biodegradable.

(D). Lather readily with water.

Q44. During liquid soap preparation it is advice to maintain one direction of turning from beginning to the end of the production in other to obtain:

(A).A foamy product

(B). A good stain remover

(C). perfectly finished product

(D). A bad product

Q45. The scum formed when soap is mixed with water could be as a result of:

(A). Calcium trioxo carbonate

(B).Propan-1,2,3-triol.

(C). Calcium hydrogen trioxo carbonate(iv).

(D). Calcium stearates

Q.46 Detergents foam in river water due to the presence of:

(A). Straight chain carbon atoms

(B). Presence of Na^+

(C). Presence of SO_4^-

(D). Presence of alkyl

Q47. The saponification of an alkanoate to produce soap and alkanol involves:

(A).Dehydration.

(B). Esterification.

(C). Hydrolysis.

(D). Oxidation.

Q.48 Liquid soap foam due to the presence of:

(A).Caustic soda

(B). Soda Ash

(C). Tetraoxosulphate (IV) acid

(D). Chloroform

Q49. Synthetic detergents are preferred to soap for laundry with hard water because:

(A) Detergents are water soluble while soaps are not

(B) The Calcium Salts of detergents are water soluble

(C) The Magnesium Salts of soap is soluble in hard water

(D) Soap does not have hydrocarbon terminal chain.

Q.50 In the laboratory preparation of detergent, Hydrogen fluoride acts as a:

(A). Catalyst

(B). Oxidizing agent

(C). Reducing agent

(D). Cleaning agent

MARKING SCHEME

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

Total 1mark ×50=50

APPENDIX D

Lesson Plans for Experimental Group

Name of the Teacher : Hadiza Muhammad- Lawal

Registration Number : M.ed/Educ/1539/2011-2012.

School : Federal College of Education Zaria.

Level : N. C. E II

Age Range : 20 – 25 years

Topic : The concepts of Saponification

Sub-Topic : Alkanoates (esters)

Lesson: 1

Week: 1

Date: 28th January 2015

Time: 4:00 – 6: 00 Pm

Duration: 2 hours

Instructional Materials: animal fats, vegetable oil, ethanol, ethanoic acid, conc H_2SO_4, 5%$NaHCO_3$, lime water, litmus paper, dil H_2SO_4, test- tubes, test- tube holder, test- tubes rack, bunsen burner, thermometer, boiling tube, beaker, stirrer, and turner.

Concepts in the lesson: Alkanoates, laboratory preparation of alkanoates, physical properties of alkanoates, chemical properties of alkanoates, uses of Alkanoates.

Specific Objectives: By the end of the lesson the students' should be able to:

a. Write the structural formulae of alkanoate.
b. Perform laboratory preparation of alkanoates (ethyl ethanoate).
c. Observe and carry out laboratory experiments to determine the physical properties of alkanoates (ethyl ethanoates) such as boiling points and melting points.
d. Carry out laboratory experiments to determine the chemical properties of ethyl ethanoates).
e. State the uses of alkanoates.

Rationale: Alkanoates are important aspects of life in that they are solvent for paints and vanishes, to hasten drying, in making perfumes and cosmetics and as artificial flavor for foods.

Previous knowledge: Students are familiar with the following concepts:

- Alkanoic acids
- Laboratory preparation of ethanoic acids
- Physical and chemical preparation of ethanoic acids

Introduction: Teacher introduces the lesson by asking students questions based on their previous knowledge as follows:

Questions.

a. What is an Alkanoic Acid.

Students respond by defining alkanoic acid as saturated aliphatic monocarboxylic acids with the general formulae $C_nH_{2n+1}COOH$.

b. Write the molecular formulae of two members of the group.

Students respond by writing formulae of two members of the group e.g CH_3COOH and C_2H_5COOH.

Presentation of the Lesson: Teacher presents the lesson according to the following steps

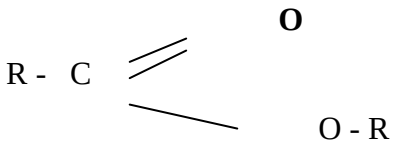
Step 1:

Students Activities

Write the general molecular and structural formula of alkanoates

Molecular formulae of alkanoates is RCOOR

Structural formulae



Where R could be hydrogen or an alkyl group and R is an alkyl group, R and R' may be the same or different.

Step 2: Laboratory preparation of ethyletheanoate

Students' Activities:

Label 3- test-tube as test- tube a, b, and c

i. Weigh about 3.00g of Shea butter into a test-tube observe carefully

ii. Measure $6cm^3$ of ethanol

iii. Measure $6cm^3$ ethanoic acid

iv. Measure 1 cm^3 of conc H_2SO_4 into test-tube (c)

Procedure:

Measure 2cm^3 of ethanol into test-tube (a) and 2cm^3 of ethanoic acid into test-tube (b), mix the two solution in a clean- dry into test-tube (c) then add few drops of conc H_2SO_4. Reflux for 5-10 minutes. Add little of the product into water. Record the oservationthat occur in test-tube (3)

Test	Observation	Inference
(a) 2cm^3 of ethanol + 2cm^3 of ethanoic acid + 1-2 drops of conc H_2SO_4 + Reflux for 5-10 minutes	Sweet fruity smell was perceived	Presence of ester
(b) mixture from (a) above + water	Slightly soluble in water	Ether is present

Equation for the reaction: $CH_3CH_2OH + CH_3COOH_{(aq)} \underset{}{\overset{H^+}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$

Ethanol ethanoic acid ethyl ethanoate water

The Conc H_2SO_4 act as a dehydrating agent in the above experiment

Step 3: Determination of boiling point of ethyl ethanoate

Students' Activities:

i. Half fill a 50cm^3 beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Attach a boiling point tube to a thermometer and insert both into beaker containing oil (oil bath) ethyl ethanoate

iii. Place about 1ml of the ester in the boiling tube

iv. Put 2-3 piece of broken porcelain to act as anti-bumpling granules

iv. Heat the beaker containing liquid paraffin gently using a bunsen-burner flame and stir the hot oil bath gently to obtain homogeneous heaing.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

The boiling point of ethylethanoate is 170^0C

Step 4: Acid and Base catalyzed hydrolysis of ethylethanoate to determine its chemical properties.

Students' Activities: Students carries out acid catalysed hydrolysis;

i. Measure $2cm^3$ of ethylethanoate into a test-tube

ii. Measure $2cm^3$ of dil H_2SO_4 into a test-tube

Procedure:

Add $2cm^3$ of ethylethanoate to $2cm^3$ of conc H_2SO_4 and heat gently in a water bath. Record your test observation and infer in the plain sheet provided. Write the equation for the reaction.

Test	**Observation**	**Inference**
$2cm^3$ of ethylethanoate + $2cm^3$ of ethanoic acid + Heat	Sweet fruity smell was perceived	Presence of ether

Equation for the reaction:

$CH_3COOCH_2CH_3$ +H-O-H $\longrightarrow$ $CH_3CH_2OH + CH_3COOH_{(aq)}$

ethyl ethanoate water Ethanol ethanoic acid

Students carry out base catalysed hydrolysis as follows:

i. Measure $2cm^3$ of ethylethanoate into a test-tube

ii. Measure $2cm^3$ of aqueous NaOH into a test-tube

Procedure: to about 2 cm^3 of ethylethanoate add $0.2cm^3$ of aqueous NaOH and heat gently for 1hour. Record your test observation and infer in the plain sheet provided. Write the equation for the reaction.

Test	**Observation**	**Inference**
$2cm^3$ of ethylethanoate + $0.2cm^3$ of aqueous NaOH + Heat	Sweet fruity smell was perceived	Presence of ether

Equation for the reaction:

$$CH_3COOC_2H_5(l) + NaOH(aq) \longrightarrow CH_3OONa(aq) + C_2H_5OH(aq)$$

Step 5: Teacher states the uses of Ethyl Ethyl ethanoates

Uses of Ethylethanoates

It is used as solvent for paints and vanishes, to hasten drying.

It is used in making perfumes and cosmetics and as artificial flavoring for foods.

Evaluation: The teacher evaluates the students by asking students questions based on what they learnt during the lesson.

Questions:

1. Write the structural formulae of Alkanoate.
2. Carry out laboratory preparation of Alkanoates (Ethylethanoate).
3. State 2 physical properties of Alkanoates (Ethylethanoates).

Carry out Laboratory experiments to determine the chemical properties of Ethyl Ethanoates.

State the uses of alkanoates.

Summary: The students make summary of their findings during the experiment as follows:

Alkanoates are sweet smelling oily organic compounds. They have a general molecular formulae RCOOR

They are prepared by reaction between an alkanol and an organic acid which forms an ester(ethyl ethanoate). This reaction is slow, reversible and catalyzed by high concentration of hydrogen ion which is call esterification reaction. The reverse reaction is hydrolysis.

Alkanol + Alkanoic Acid $\longrightarrow$ Alkyl Alkanoate(Ester) + water

Physical properties of ethyl ethanoate

It is colourless volatile liquid with a pleasant smell.

It is slightly soluble in water but very soluble in organic solvents.

Chemical properties

Hydrolysis

Alkanoates can be hydroysed back into acid and ankanols. The hydrolysis could be acid or base catalysed.

Acid catalysed hydrolysis

$$CH_3COOC_2H_5(l) + H_2O \xrightleftharpoons{H^+} CH_3COOH(aq) + C_2H_5OH\ (aq)$$

Base Catalysed Hydrolysis

$CH_3COOC_2H_5(l) + NaOH(aq) \longrightarrow CH_3COONa(aq) + C_2H_5OH\ (aq)$

Uses of Ethyl Ethanoate

It is used as solvent for paints and vanishes, to hasten drying.

It is used in making perfumes and cosmetics and as artificial flavouring for foods.

Conclusion: The teacher concludes the lesson by giving the students Notes to Copy

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Federal College of Education Zaria.

Level: N.C.E II

Age Range: 20 – 25 years

Topic: Concepts of Saponification

Sub-Topic: Fats

Lesson: 2

Week: 2

Date : 4th February 2015

Time: 4: 00 – 6: 00 Pm

Duration: 2 hours

Instructional Materials: Fresh animal milk, beaker, cork, bottle, boiling tube, stirrer, test tubes.

Concepts in the lesson: fats, physical and chemical properties of fats, test for the present fats.

Specific Objectives: By the end of the lesson the students' should be able to:

a. identify the reagents and apparatus use during the production of fats

b. carry out laboratory preparation of fats

c. carry out laboratory experiments to determine the boiling point and melting points of fats.

d. carry out laboratory test for the presence of fats.

e. carry out laboratory experiments to determine the chemical properties of fats.

Rationale: fats and oils are important because they are use in food industries, in cosmetics, production of soaps and detergents.

Previous knowledge: Students are familiar with the following concepts;

- alkanoates.
- laboratory preparation ethylethanoate.
- physical and chemical preparation of ethylethanoate.

Introduction: The teacher introduces the lesson by asking students questions based on their previous knowledge as follows:

Questions

1. Define ethylethanoate

Students respond by defining alkanoates as sweet smelling oily organic compounds.

2. Using chemical equations illustrate how alkanoates are prepared in the laboratory.

Students respond by writing equations for the laboratory preparation of alkanoates

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \xrightleftharpoons[150^{O}\,C]{H^{+}} CH_3COOC_2H_5(l) + H_2O(l)$$

Presentation: The teacher presents the lesson according to the following steps

Step 1; Identification of reagents and apparatus use during the production of fats

Students Activities: students observe and write the reagents and apparatus on the demonstration bench which are; 4 litres fresh animal(cow) milk, shaking bottle beaker, boiling point tube, stirrer, test tubes

Step 2: Laboratory preparation of fats.

Students' Activities:

i. Measure $25cm^3$ of fresh animal milk in to clean dry container and cork tightly

ii. Attach the corked flask on a shaker machine,

iii. Shake vigorously for about 30 minutes

iv. Pour into a beaker and allow settling for 10-15minutes

v. Decant carefully the liquid part to separate the oily floating particle from the milky suspension.

Record your observations and inference

Test	**Observation**	**Inference**
Step 1: Shake $25cm^3$ of the animal fat for 30minutes allow to settle for 10minutes and carefully decant the liquid part	Oily particles floating on milky liquid suspension were observed	Animal fat is present

Step 3: The students' carryout test for the presence of fat in an unknown substance

Students Activities: the students carries out test for the presence of fat in an unknown substance, write their observations and inference.

Test for fats and oils

Test	**Observation**	**Inference**
Shake $5cm^3$ of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Conclusion; the sample is fat

Step4: The students carry out laboratory experiments to determine the boiling point of fats.

Students' Activities:

i. Half fill a $50cm^3$ beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Clamp a boiling point tube with liquid sample(ethyl ethanoate) and thermometer in such a way that the thermometer will touch the liquid sample (ethyl ethanoate)

iii. Put 2-3 piece of broken porcelain to act as anti-bumpling granules

iv. Heat the beaker containing liquid paraffin slowly using a bunsen-burner flame and stir gently.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

Fats do not have a sharp boiling point

Evaluation. The teacher evaluates the lesson by asking students questions based on what was taught during the lesson.

Questions.

a. Identify the reagents and apparatus use during the production of fats

b. carry out laboratory preparation of fats

c. carry out laboratory experiments to determine the boiling point of fats.

d. carry out laboratory test for the presence of fats.

Summary: The students' summarizes the results of their findings during the experiment. Fats are solids, usually of animal origin. Pure fats do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Conclusion: The teacher concludes the lesson by allowing students to ask relevant Questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Federal College of Education Zaria.

Level: N.C.E II

Age Range: 20 – 25 years

Topic: Saponification

Sub-Topic: Laboratory preparation of oil

Lesson: 3

Week: 3

Date: 15th February 2015

Time: **9: 00 – 10: 00 am**

Duration: 2 hours

Instructional Materials: 1g of ground nuts, blender,bowl, pistel, beaker, petric dish, bunsen burner, boiling point tube, stirrer, test tubes.

Concepts in the lesson: oil, physical and Chemical Properties of oil, test for oil.

Specific Objectives: By the end of the lesson the students' should be able to:

a. Identify the reagents and apparatus use during the production of oil

b. carry out preparation of oils in the laboratory

c. carry out laboratory experiments to determine the boiling point and melting points of oil.

d. carry out laboratory test for the presence of oil.

e. carry out laboratory experiments to determine the chemical properties of oil.

Rationale: Fats and oils are important because they are use in food industries, in Cosmetics etc

Previous knowledge: Students are familiar with the following concepts;

- Alkanoates.
- Laboratory preparation ethylethanoate.
- Physical and chemical preparation of ethylethanoate.

Introduction: The teacher introduces the lesson by asking students questions based on their previous Knowledge as follows:

Questions

Define ethylethanoate

Students respond by defining Alkanoates as sweet smelling oily organic compounds.

Using Chemical Equations illustrate how Alkanoates are prepared in the Laboratory.

Students respond by writing equations for the laboratory preparation of Alkanoates

$$H^+ + / 150^O C$$

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$$

Presentation: The teacher presents the lesson according to the following Steps

Step 1; Identification of reagents and apparatus use during the production of oil

Students Activities: students observe and write the reagents and apparatus on the demonstration bench which include; 1kg of groundnut oil, a bowl, pistle, beaker, petric dish, bunsen burner, boiling point tube, stirrer, test tubes

Step 2 : Laboratory preparation of fats.

Students' Activities:

Weigh 5g of groundnuts, pour into a petric dish fry for 3minutes, blend into a paste, pour the groundnut paste into a bowl and add $10cm^3$ of water stir for 20minutes until an oilly substance comes out. Collect the substance into a test tube or a beaker. Carry out test for the presence of oil.

Test for oils

Test	**Observation**	**Inference**
Shake $5cm^3$ of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Conclusion; The liquid sample is a fat

Step 3: The students carry out laboratory experiments to determine the boiling point and melting points of fats.

Students' Activities:

i. Half fill a $50cm^3$ beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Clamp a boiling point tube with liquid sample(ethyl ethanoate) and thermometer in such a way that the thermometer will touch the liquid sample (ethyl ethanoate)

iii. Put 2-3 piece of broken porcelain to act as anti-bumpling granules

iv. Heat the beaker containing liquid paraffin slowly using a bunsen-burner flame and stir gently.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

Oil does not have a sharp boiling point.

Step 4: the students carry out laboratory experiments to determine the chemical properties of fats. alkaline hydrolysis of oil (Saponification)]

Students Activities: The students carry out alkaline hydrolysis of oil (Saponification);

Students Activities:

i. Measure $10cm^3$ of palm kernel oil into a clean dry container
ii. Weigh 0.8g of sodium hydroxide (caustic soda)

Procedure:

i. Dissolve 0.8g sodium hydroxide (caustic soda) in $5cm^3$ of water to make sodium hydroxide solution
ii. Add the solution above to a hot boilled $10cm^3$ of palm kernel oil and stir thoroughly to ensure complete solution.
iii. Quickly transfer the mixture into a desired shaped dry container and allow standing for 4-6hours at ordinary temperature. Record your observations and inference

Test	**Observation**	**Inference**
NaOH + water NaOH Solution + boiled palm kernel oil	NaOH is soluble in water The solution of palm kernel oil decolorizes the palm kernel oil to pure white suspension and thickens immediately.	Presence of soluble salt. Soap is formed

In the reaction above the NaOH hydrolysis the palm kernel oil and the reaction is call saponification reaction.

Evaluation: the teacher evaluates the students learning outcome by asking them the following questions

Questions.

a. Identify the reagents and apparatus use during the production of fats

b. Carry out laboratory preparation of fats

c. Carry out laboratory experiments to determine the boiling point and melting points of fats.

d. Carry out laboratory test for the presence of fats.

e. Carry out laboratory experiments to determine the chemical properties of fats.

Summary: The students' summarizes the results of their findings during the experiment.

Fats are solids, usually of animal origin. Pure fats and oils are colorless almost white and odorless, they do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Differences between fats and oil

Fats are less saturated while oils are more saturated.

Fats are solids usually of animal origin while oils are liquids usually from plants.

Chemical properties of Fats and Oils

Hydrogenation of vegetable oils (production of margarine);

Fats/Oils + H_2 $\xrightarrow{\text{Nickel/5atm/180}^0\text{C}}$ Margarine.

Combustion; fats and oil burns in oxygen to form carbon (IV) oxide and water.

Alkaline hydrolysis of fats (saponification);

Saponification is the alkaline hydrolysis of fats and oils. It is the process of making soap.

Conclusion: The teacher concludes the lesson by allowing students to ask relevant Questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Federal College of Education Zaria.

Level : N.C.E II

Age Range: 20 – 25 years

Topic: Saponification

Sub-Topic: Laboratory preparation of Soaps

Lesson: 4

Week: 4

Date : 15th February 2015

Time: 9: 00 – 11: 00 am

Duration: 2 hours

Instructional Materials: palm Oil, NaOH solution,saturated sodium chloride solution (brine) Water.

Concepts in the Lesson: laboratory preparation of soap, cleansing action of soap, Laboratory, similarities between soaps and detergents, advantage of soap over detergent.

Behavioural objectives**:** By the end of the lesson the students' should be able to

i. Describe the preparation of soap in the laboratory.
ii. Write equations to represent laboratory preparation of soap.
iii. State the similarities between soaps and detergents
iv. State 2-similarities and 2-differences between soaps and detergents.

Rationale: Soaps are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are familiar with the following concepts;

- Fats and Oils,
- Physical and Chemical Properties of Fats and Oils
- Differences between Fats and Oils.

Introduction: The teacher introduces the lesson by asking students questions based on their previous Knowledge as follows:

Questions 1: Define Fats and Oils.

Students Respond: Students Respond by defining Fats and Oils as Esters of long chain Fatty Acids and propan-1,2,3-triol.

Question 2: State the Physical Properties of Fats and Oils.

Students Respond: Students Respond by Stating the Physical Properties of Fats and Oils as

- Fats and oils are colourless almost white and odourless which is due to the presence of small quantity of non – fatty substances
- They do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters)
- They are insoluble in water but soluble in organic compounds such as alcohols

Presentation: The teacher presents the lesson according to the following steps

Step 1; Students' set the laboratory, collect the reagents need for the conduct of the experiment. Reagents and apparatus for the preparation of Soaps are; palm oil, NaOH solution, sodium chloride solution (brine), water, beaker, burner, stirrer, measuring cylinder.

Step 2; Students carry out Laboratory preparation of Soaps while the teacher guides them

Laboratory preparation of Soap

The students Boil about $5cm^3$ of palm oil in a beaker and add $25cm^3$ of 2M NaOH solution to it they stir carefully during the addition. They continue to boil and stir until the oil layer disappears. They then allow the mixture to cool and then add about $25cm^3$ of saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

Step 3; Students identify the similarities difference between Soaps and detergents while the teacher guides them.

Similarities between soaps and detergents

They are both cleansing agents.

They are both synthesised from fats and oils.

They all contain Alkyl groups.

Differences between soaps and detergents

Soap is sodium or potassium salt of a long chain carboxylic acid, while detergent is sodium or potassium salt of long chain Alkyl hydrogentetraoxosulphate (IV),

Soap can be represented by the general formulae $R\text{-}CO_2Na$, while detergents can be represented by

$R\text{-}OSO^-_3Na^+$

Soap has a long non-polar alkylgroup R, while detergent has a long non-polar alkylgroup R, and a polar group $OSO^-_3Na^+$ which is responsible for their cleansing properties.

Soap produces dirty-white scum in hard water because their calcium and magnesium salts are water soluble.

Step 4: Students are allowed to recognize the advantages of soaps over detergents as the teacher guides them.

Advantages of Soap over Detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable and

Evaluation ; the teacher evaluates the students by asking them questions based on what was taught during the lesson.

Questions.

a. Perform skilfully laboratory preparation of soap.

b. Write equations for the laboratory preparation of soap.

c. State two advantages of soaps over detergents.

d. State 2- similarities and differences between soaps and detergents.

Summary; The teacher summarizes the lesson by re explaining the key points in the lesson.

Boil about $5cm^3$ of palm oil in a beaker. Add $25cm^3$ of 2M NaOH solution to it, stirring during the addition. Continue to boil and stir until the oil layer disappears. Allow to cool

add about 25cm^3 of saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

Advantages of Soap over Detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable and

Conclusion; the teacher concludes the lesson by allowing students to ask questions

Name of School: Federal College of Education Zaria.

Level : N.C.E II

Age Range: 20 – 25 years

Topic: Saponification

Sub-Topic: Laboratory preparation of Detergents

Lesson: 5

Week: 5

Date: 30th February 2015

Time: 4:00- 6 : 00 pm

Duration: 2 hours

Instructional Materials: sodium, ethanol, Conc H_2SO_4, dilute NaOH, beaker, buner, stirrer, measuring cylinder.

Concepts in the Lesson: laboratory preparation of detergents, advantage of detergent over soap, similarities between soaps and detergents.

Behavioural Objectives: By the end of the lesson the students' should be able to

a. Perform laboratory preparation of detergent

b. Write equations for the laboratory preparation of detergent.

c. State 2-similarities and differences between soaps and detergents.

Rationale: Detergents are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are familiar with the following concepts;

- How to prepare soap in the Laboratory
- Equations for the Laboratory preparation of soap
- Advantages of Soaps over Detergents

Introduction: The teacher introduces the lesson by asking students questions based on their previous Knowledge as follows:

Questions

i. State the reagents required for the preparation of Soaps

Students respond by stating the following reagents use during Laboratory preparation of Soaps: palm oil, NaOH solution, sodium chloride solution (brine), water.

ii. States how Soaps are prepared in the Laboratory

Students respond by stating how soaps are prepared in the laboratory as follows

Laboratory preparation of soap

Soaps are prepared in the laboratory by boiling palm oil in a beaker. Add NaOH solution to it, stir carefully during the addition. Continue to boil and stir until the oil layer disappears. Allow to cool add about $10cm^3$ saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

iii. State 2- advantages of soaps over detergents

Students respond by stating advantage of soaps over detergents as follows:

Advantages of soap over detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable.

Presentation: the teacher presents the lesson according to the following steps

Step 1; Reagents and apparatus use during the production of detergent.

Students Activities: The students' set the laboratory, collect the reagents and apparatus need for the conduct of the experiment while the teacher guides them. Reagents required is sodium, ethanol, Conc H_2SO_4, dilute NaOH.

Apparatus required for the laboratory preparations of detergents are; Beaker, Burner, Stirrer, Ovum, measuring cylinder.

Step 2; Laboratory preparation detergent

Students Activities

i. Measure $25cm^3$ hexadecanoic acid in a beaker

ii. Measure about 20cm3 NaOH into a beaker and $5cm^3$ of ethanol; into another beaker

iii. Measure 25cm3 Conc H2SO4

Procedure: add the sodium hydroxide to ethanol then add hexadecanoic acid to the solution of sodium hydroxide and ethanol to give fatty ethanol(alcohol).

The Equation for the reaction: $CH_3(CH_2)_{16}COOH + 2[H] \longrightarrow CH_3(CH_2)_{16}CH_2OH$

Measure $20cm^3$ Conc H_2SO_4 and $20cm^3$ fatty ethanol prepared above and add the Conc H_2SO_4 to fatty ethanol to give Alkyl hydrogen tetraoxosulphate (VI) acid then add 10cm dilute sodium hydroxide to neutralize the acid to obtain the detergent.

$CH_3CH_2)_{16}CH_2\text{-}OSO_3H + NaOH \longrightarrow CH_3(CH_2)_{16}CH_2\text{-}OSO_3Na + H_2O.$

They are represented by the general formulae R-OSO3Na. The R- represents the straight chain carbon atoms which make detergents biodegradable and bring about foaming in river.

Step 3: Similarities and difference between Soaps and detergents while the teacher guides them.

Students' Activities: Students identify similarities between soaps and detergents as follows:

They are both cleansing agents.

They are both synthesized from fats and oils.

They all contain Alkyl groups.

Students' identify differences between soaps and detergents as follows:

Soap is sodium or potassium salt of a long chain carboxylic acid, while detergent is sodium or potassium salt of long chain alkylhydrogentetraoxosulphate (IV),

Soap can be represented by the general formulae $R\text{-}CO_2Na$, while detergents can be represented by $R\text{-}OSO^-_3Na^+$,

Soap has a long non-polar alkylgroup R, while detergent has a long non- polar alkyl group R, and a polar group $OSO^-_3Na^+$ which is responsible for their cleansing properties.

Soap produces dirty-white scum in hard water because their calcium and magnesium salts are water soluble while detergents don't.

Step 4: Students are allowed to recognize the advantages of detergents over soaps as the teacher guides them.

Students' Activities: Advantages of Detergents over Soap

Unlike soap detergents retain their cleansing property irrespective of water used. They neither form scum in hard water nor react with hydrogen ion in acidic water.

Evaluation; the teacher evaluates the students by asking them questions based on what was taught during the lesson.

Questions.

a. Perform laboratory preparation of detergents.

b. Write equations for the laboratory preparation of detergents.

c. State 2-advantages of soaps over detergents

d. State 2- similarities and differences between soaps and detergents.

Summary: The students summarizes the results of their findings during the experiment as follows:

Synthetic detergents are prepared by reducing fatty acid using sodium in ethanol to give fatty ethanol.

$$CH_3(CH_2)_{16}COOH + 2[H] \longrightarrow CH_3(CH_2)_{16}CH_2OH$$

The alcohol is then treated with Conc H_2SO_4 in ratio 1:1 to give the Alkylhydrogentetraoxosulphate (VI).The Alkylhydrogentetrasulpahte (VI) (acidic) is neutralised with dilute NaOH solution to obtain the detergent.

$CH_3CH_2)_{16}CH_2\text{-}OSO_3H + NaOH \longrightarrow CH_3(CH_2)_{16}CH_2\text{-}OSO_3H + H_2O.$

They are represented by the general formulae $R\text{-}OSO_3Na$. The R- represents the straight chain carbon atoms which make detergents biodegradable and bring about foaming in river

Advantages of Detergents over Soap

Unlike soap detergents retain their cleansing property irrespective of water used. They neither form cum in hard water nor react with hydrogen ion in acidic water. Besides, detergents have a wider application than soap because they can be tailor-made for specific purposes.

Conclusion; the teacher concludes the lesson by allowing students to ask questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Federal College of Education Zaria.

Level: N.C.E II

Age Range: 20 – 25 years

Topic: Concepts in Saponification

Sub-Topic: Liquid Soap Production

Lesson: 6

Week: 6

Date : 19th February 2015

Time: 4:00- 6 : 00 pm

Duration: 2 hours

Instructional Materials: Sodaash, sodiumchlorine, sulphate, colorant, perfume (fragrance), alkyl benzene sulphonic acid, antisal(starch), caustic soda, soda ash, stirrer and containers

Concepts in the Lesson: Liquid soap production

Behavioral objectives: By the end of the lesson the students' should be able to identify

a. Identify the reagents use for the production of liquid soap.

b. Identify the uses of each reagent use during liquid soap production.

c. Produce liquid soap

Rationale: soaps are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are familiar with the following concepts;

- Fats and oils

-The physical and chemical properties of fats and oils

-Test for the presence of fats and oils in a compound

Introduction: The teacher introduces the lesson by asking the students the following questions

Questions

1. Define fats and oils.

Students respond by defining fats and oils aas higher alkanoates. They are esters of long chain fatty acids and propan-1, 2, 3-triol

2. State the physical and chemical properties of fats and oils.

Students respond by stating the physical and chemical properties of fats and oils as follows:

Physical Properties;

Pure fats and oils are colorless almost white and odorless which is due to the presence of small quantity of non – fatty substances

They do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Chemical Properties

Hydrogenation of vegetable oils (production of margarine); oils are converted in to fats by hydrogenation .this is done by bubbling hydrogen into the oil at about 5atm and temperature of 180^0C in the presence of finely divided Nickle as a catalyst until the product is fairly hardened. Milk, common salts, vitamins A and B are then added.

$$Fats/Oils + H_2 \xrightarrow{Nickel/5atm/180^0C} Margarine.$$

Alkaline hydrolysis of fats (Saponification)**;** Saponification is the alkaline hydrolysis of fats and oils. It is the process of making soap. The fat and oils is hydrolysed with either sodium hydroxide solution or potassium soap of fatty acid (soft soap). Propan- 1,2,3 – triol (glycerol) is also formed as bye produce.

Fats or Oil in caustic alkali $\rightarrow$ Soap + Propan – 1,2,3 – triol

4. Describe a test to identify the presence of fats and oils in a compound.

Students Respond. The students respond by describe a test to identify the presence of fats and oils in a compound as follows

Test for fats and oils

Test	**Observation**	**Inference**
Shake 5cm of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Presentation: The teacher presents the Lesson according to the following steps

Step 1; students' identifies the reagents and apparatus needed for the production of liquid soap.

Students Activities:

Reagents for production of liquid soap: Antisal (starch)/Nitrosol, Caustic Soda, Soda Ash, Sodium thio Sulphate, CitricAcid, Colorant, Perfume (fragrance),Alkyl benzene Sulphonic acid and water.

Apparatus use during the production of liquid soap includes; 25 liters bowl, steering stick, hydrometer and weigh balance.

Step 2; the students' identify the use of each reagent and apparatus use during liquid soap production.

Students Activities: Uses of reagents and apparatus use during liquid soap production

Antisal (starch): It serves as a thickner because it thickens the liquid soap.

Caustic soda (NaOH): Hydrolyze fat and oil to give propane 1,2,3-triol and soap. It is also a stain remover.

Soda Ash: It helps in regulating caustic soda.

Sodium thio sulphate: It is a foaming agent.

Color: It gives the liquid soap color

Water: for liquidation

Perfume: It produces fragrance /Scent.

Alkylbenzenesulphonic acid: It is also a foaming agent.

Citric acid: provide vitamins to protect your skin

Hydrometer: to measure the acidity of both the caustic soda and soda ash.

Weigh balance. To weigh the reagents used

Step 3; the students use the weighing balance to measure required amount of reagents to be used during the liquid soap production process.

Students Activities:

i. Weigh 1/4kg Nitrosol
ii. Weigh 1/4kg Caustic Soda
iii. Weigh 1/2kg Soda Ash
iv. Sodium thio Sulphate
v. Measure 100g CitricAcid
vi. Weigh 1kg Colorant
vii. Measure 10cm Perfume (fragrance)
viii. Measure 1lit Sulphonic acid
ix. Measure 25lit of Water

Step 4; the Students carry out the production of liquid soap.

Students Activities: Pour the water in to a wide bowl and then add the Nitrosol and stir for 5minutes when the solution thickness add soda ash and stir for 5minute insert the hydrometer in to the solution to measure the concentration of the soda ash (which should be 1250),add Sulphonic acid and stir for 10minutes, add sodium thio sulpate and stir for 3minutes, add caustic soda and stir insert the hydrometer in to the solution to measure the concentration of the caustic soda (which should be 1275) then add citric acid to the solution and stir for 3minutes, add perfume and color then stir for 10minutes.

Note: The stirring is to be in one direction so as to get a good finished product.

Evaluation: the teacher evaluates students learning out come by asking the following questions:

The teacher issue a liquid soap production manual to the students and evaluates the students learning outcome by asking them to produce liquid soap and use the observation check list to evaluate their skills and ask the following questions.

a. Identify the reagents use for the production of liquid soap.

b. Identify the uses of each reagent use during liquid soap production.

c. Produce liquid soap

Summary; the students summarizes the the procedures in liquid soap production

Reagents for production Liquid soap: Antisal (starch)/Nitrosol, Caustic Soda, Soda Ash, Sodium thio Sulphate, CitricAcid, Colorant, Perfume (fragrance),Alkyl benzene Sulphonic acid and water.

Apparatus for liquid Soap Production ; 25 liters bowl, stearing stick, hydrometer, weigh balance.

Liquid soap is prepared by;

Pouring water in to a wide bowl and then add the Nitrosol and stir for 5minutes when the solution thickness add soda ash and stir for 5minutes,add Sulphonic acid and stir for 10minures, add sodium thio sulpate and stir for 3minutes, add caustic soda and stir at this point insert the hydrometer in to the solution to measure the concentration of both the caustic soda and the soda ash. The required value for the concentration is 1275 for caustic soda and 1250 for the soda ash. then, add citric acid to the solution and stir for 3minutes, add perfume and colour then stir for 10minutes.

Conclusion; the teacher concludes the lesson by allowing students ask questions based on what they were taught during the lesson.

Lesson Plan for Control Group.

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/2011-2012

Name of School: Isah Kaita College of Education Dutsenma.

Level: N.C.E II

Age Range: 20 – 25 years

Topic: Concepts in Saponification

Sub-Topic: Alkanoates (esters)

Lesson: 1

Week: 1

Date: 4th March 2015

Time: 4:00- 6: 00 pm

Duration: 2 hours

Instructional Materials**:** animal fats, vegetable oils and litmus paper.

Concepts in the lesson: Alkanoates, laboratory preparation of Alkanoates, physical properties of alkanoates, chemical properties of Alkanoates, uses of Alkanoates.

Behavioural Objectives: By the end of the lesson the students' should be able to:

a. Write the structural formulae of alkanoate.

b. Perform laboratory preparation of alkanoates (Ethyl Ethanoate)

c. Observe and write the physical properties of Alkanoates (Ethyl Ethanoate)

d. Write equation to illustrate the chemical properties of Alkanoates (Ethyl Ethanoates).

Rationale: Alkanoates are important aspect of life in that they are use as solvent for paints and vanish, to hasten drying, in making perfumes and cosmetics and as artificial flavouring for foods.

Previous knowledge: Students are familiar with the following concepts;

- Alkanoic acids,
- Laboratory preparation of ethanoic acids,
- Physical and chemical preparation of ethanoic acids.

Introduction: The teacher introduces the lesson by asking students questions based on their previous Knowledge as follows:

Questions.

i. Define Alkanoic Acid.

Students respond by defining Alkanoic Acid as Saturated aliphatic monocarboxylic Acids with the general formulae $C_nH_{2n+1}COOH$.

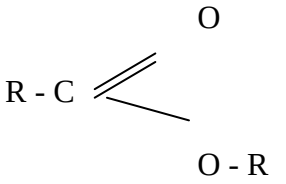
ii. Write the molecular formulae of two members of the group.

Students respond by writing formulae of two members of the group e.g CH_3COOH and C_2H_5COOH.

Presentation: Teacher presents the lesson according to the following steps

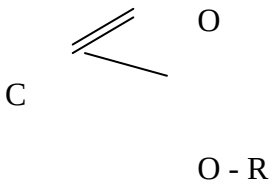
Step 1; The teacher defines alkanoates(esters) and esterification and give an example of Alkanoate (Shea Butter).

Alkanoates are sweet smelling oily organic compounds. They are found naturally in fruits, flowers and leaves. They are responsible for the sweet smell of flowers and fruits. They are the main constituents of many naturally occurring fats and oils. They have a general molecular formulae RCOOR and structure



Where R could be hydrogen or an alkyl group and R is an alkyl group, R and R' may be the same or different.

Their functional group is carboxylate group (i.e. – COOR)



Esterification**:** This is a reaction between an alkanol and an acid to form an ester(Ethyl Ethanoate). This Reaction is slow, reversible and catalyzed by high concentration of Hydrogen ion. The reverse reaction is hydrolysis

Alkanol + Alkanoic Acid $\longrightarrow$ Alkylalkanoate(Ester)

Step 2: Teacher states how ethylethanoate is been prepared in the laboratory as follows: Ethylethanoate is prepared by the reaction of ethanol and glacial ethanoic acid at 1500C in the presence of concentrated tetraoxosulphate (VI) acid as catalyst.

$$H^+ + / 150^O C$$

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$$

Step 3: The teacher states the physical and chemical properties of Ethyl Ethanoate

Physical properties of ethylethanoate

It is colourless volatile liquid with a pleasant smell.

It has a boiling point of 75^0C.

It is slightly soluble in water but very soluble in organic solvents.

Step 4 : the teacher states the chemical properties of ethylethanoate

Chemical properties of ethylethanoate

Hydrolysis; Alkanoates can be hydroysed back into acid and ankanols. The hydrolysis could be acid or base catalysed.

Acid catalysed hydrolysis: This is carried out by boiling the alkanoates with dilute tetraaxosulphate (VI) acid.

$$CH_3COOC_2H_5(l) + NaOH(aq) \xleftrightarrow{H^+} CH_3OOH(aq) + C_2H_5OH(aq)$$

2. Base Catalysed Hydrolysis

This is carried out by boiling the akanoate with dilute sodium hydroxide solution.

$$CH_3COOC_2H_5(l) + NaOH(aq) \longrightarrow CH_3OONa(aq) + C_2H_5OH(aq)$$

Ethanol is distilled off from the reaction mixture and the residual solution is acidified with dilute tetraoxosulphate (VI) acid to obtain the alkanoic acid.

$$2CH_3COONa\,(aq) + H_2SO_4\,(aq) \longrightarrow 2CH_3COOH\,(aq) + Na_2SO_4\,(aq)$$

Ethanol is distilled off from the reaction mixture and the residual solution is acidified with dilute tetraoxosulphate (VI) acid to obtain the

Evaluation

Teacher asks students' questions based on what they have learnt during the lesson to evaluate their learning outcome.

a. Write the structural formulae of Alkanoate.

b. Perform (skillfully) laboratory preparation of Alkanoates (Ethyl Ethanoate)

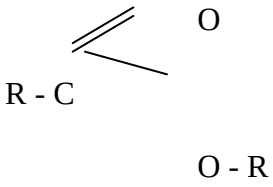
c. write the physical properties of Alkanoates(Ethyl Ethanoate)

d. write equation to illustrate chemical reactions Alkanoates (Ethyl Ethanoates) under goes.

Summary

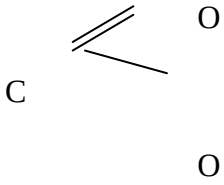
The teacher summarizes the lesson by re-explaining the main points in the lesson

Alkanoates are sweet smelling oily organic compounds. They are found naturally in fruits, flowers and leaves. They have a general molecular formulae RCOOR and structure



Where R could be hydrogen or an alkyl group and R is an alkyl group, R and R' may be the same or different.

Their functional group is carboxylate group (i.e. – COOR)



Esterification: This is a reaction between an alkanol and an acid to form an ester(Ethyl Ethanoate).

Alkanol + Alkanoic Acid ⟶ Alkyl alkanoate(Ester)

Laboratory preparation of ethylethanoate

ethylethanoate is prepared by the reaction of ethanol and glacial ethanoic acid at 1500C in the presence of concentrated tetraoxosulphate (VI) acid as catalyst.

$$H^+ + / 150^O\ C$$

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$$

Physical properties of ethylethanoate

It is colourless volatile liquid with a pleasant smell.

It has a boiling point of 75^0C.

Chemical properties of ethylethanoate

Alkanoates undergoes acid or base catalysed hydrolysis

Acid catalysed hydrolysis. This is carried out by boiling the alkanoates with dilute tetraaxosulphate (VI) acid.

$$CH_3COOC_2H_5(l) + NaOH(aq) \xleftrightarrow{H^+} CH_3OOH(aq) + C_2H_5OH(aq)$$

Base Catalysed Hydrolysis

This is carried out by boiling the alkanoate with dilute sodium hydroxide solution.

$$CH_3COOC_2H_5(l) + NaOH(aq) \longrightarrow CH_3OONa(aq) + C_2H_5OH(aq)$$

Conclusion: The teacher concludes the lesson by allowing students to copy notes to copy.

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Isah Kaita College of Education Dutsenma.

Level : N.C.E II

Age Range : 20 – 25 years

Topic : Saponification

Sub-Topic : Fats

Lesson: 2

Week: 2

Date : 4th march 2015

Time: 10:30- 12 : 30 pm

Duration: 2 hours

Instructional Materials: Fresh animal milk, beaker, cork, bottle, boiling point tube, stirrer, test tubes.

Concepts in the lesson: fats, physical and chemical properties of fats, test for the present fats.

Specific Objectives: By the end of the lesson the students' should be able to:

a. identify the reagents and apparatus use during the production of fats

b. carry out laboratory preparation of fats

c. carry out laboratory experiments to determine the boiling point and melting points of fats.

d. carry out laboratory test for the presence of fats.

e. carry out laboratory experiments to determine the chemical properties of fats.

Rationale: fats and oils are important because they are use in food industries, in Cosmetics etc

Previous knowledge: Students are familiar with the following concepts;

- alkanoates.
- laboratory preparation ethylethanoate.
- physical and chemical preparation of ethylethanoate.

Introduction: Teacher introduces the lesson by asking students questions based on their previous knowledge as follows:

Questions

i. Define ethylethanoate

Students respond by defining alkanoates as sweet smelling oily organic compounds.

ii. Using chemical equations illustrate how alkanoates are prepared in the laboratory.

Students respond by writing equations for the laboratory preparation of alkanoates

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \xrightleftharpoons{H^+ + / 150^O C} CH_3COOC_2H_5(l) + H_2O(l)$$

Presentation: Teacher presents the lesson according to the following steps;

Step 1; Identification of reagents and apparatus use during the production of fats

Teacher name the reagents and apparatus use during the production of fats as follows; 4-liters fresh animal(cow) milk, shaking bottle beaker, boiling point tube, stirrer, test tubes

Step 2: the teacher states how fats are prepared in the laboratory

Fats are prepared using animal milk. The animal milk is poured into a bottle corked. The milk is shacked for about 30minutes then pour into a beaker and allow settling for about 10minutes. There will be oily particles floating on milky liquid.

Step 3: The teacher states how to carryout test for the presence of fats

Test for fats and oils

Test	Observation	Inference
Shake $5cm^3$ of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Conclusion; the sample is fat

Step4: The teacher states how to carryout laboratory experiments to determine the boiling point of fats.

i. Half fill a $50cm^3$ beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Clamp a boiling point tube with liquid sample(ethyl ethanoate) and thermometer in such a way that the thermometer will touch the liquid sample (ethyl ethanoate)

iii. Put 2-3 piece of broken porcelain to act as anti-bumpling granules

iv. Heat the beaker containing liquid paraffin slowly using a bunsen-burner flame and stir gently.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

Fats do not have a sharp boiling point

Evaluation. The teacher evaluates the lesson by asking students questions based on what was taught during the lesson.

Questions.

a. Identify the reagents and apparatus use during the production of fats

b. carry out laboratory preparation of fats

c. carry out laboratory experiments to determine the boiling point of fats.

d. carry out laboratory test for the presence of fats.

Summary: The teacher summarizes the main points in the lesson.

Fats are solids, usually of animal origin. Pure fats do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Conclusion: The teacher concludes the lesson by allowing students to ask relevant Questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Isah Kaita College of Education Dutsenma.

Level : N.C.E II

Age Range : 20 – 25 years

Topic : Saponification

Sub-Topic : Oil

Lesson : 3

Week : 3

Date : 28th February 2015

Time: 4:00- 6 : 00 pm

Duration: 2 hours

Instructional Materials: 1g of ground nuts, blender,bowl, pistel, beaker, petric dish, bunsen burner, boiling point tube, stirrer, test tubes.

Concepts in the lesson: oil, physical and Chemical Properties of oil, test for oil.

Specific Objectives: By the end of the lesson the students' should be able to:

a. Identify the reagents and apparatus use during the production of oil

b. carry out preparation of oils in the laboratory

c. carry out laboratory experiments to determine the boiling point and melting points of oil.

d. carry out laboratory test for the presence of oil.

e. carry out laboratory experiments to determine the chemical properties of oil.

Rationale: Fats and oils are important because they are use in food industries, in Cosmetics etc

Previous knowledge: Students are familiar with the following concepts;

- Alkanoates.
- Laboratory preparation ethylethanoate.
- Physical and chemical preparation of ethylethanoate.

Introduction: The teacher introduces the lesson by asking students questions based on their previous knowledge as follows:

Questions

i. Define ethylethanoate

Students respond by defining Alkanoates as sweet smelling oily organic compounds.

ii. Using Chemical Equations illustrate how Alkanoates are prepared in the Laboratory.

Students respond by writing equations for the laboratory preparation of Alkanoates

$$H^+ + / 150^O C$$

$$CH_3COOC_2H(l) + C_2H_5OH(aq) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$$

Presentation: The teacher presents the lesson according to the following Steps

Step 1; Identification of reagents and apparatus use during the production of oil

The teacher write the reagents and apparatus use during the preparation of fats as follows: groundnut oil, a bowl, pistle, beaker, petric dish, bunsen burner, boiling point tube, stirrer, test tubes

Step 2: the teacher states how fats are prepared in the laboratory.

Fats could be prepared in the laboratory by weighing a required amount of groundnuts, pour into a petric dish fry , blend into a paste, pour the groundnut paste into a bowl and add water stir until an oily substance comes out. Collect the substance into a test tube or a beaker. Carry out test for the presence of oil.

Test for oils

Test	Observation	Inference
Shake $5cm^3$ of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Conclusion; the liquid sample is a fat

Step 3: The teacher states how to determine the boiling point and melting points of fats in the laboratory.

i. Half fill a beaker with liquid paraffin and place it on a tripod stand with wire guaze

ii. Clamp a boiling point tube with liquid sample (ethyl ethanoate) and thermometer in such a way that the thermometer will touch the liquid sample (ethyl ethanoate)

iii. Put 2-3 piece of broken porcelain to act as anti-bumpling granules

iv. Heat the beaker containing liquid paraffin slowly using a bunsen-burner flame and stir gently.

v. Record the temperature at which the liquid starts to boil.

Note liquid paraffin is use because the boiling point of ethyl ethanoate is greater than 90^0C.

Oil does not have a sharp boiling point.

Step 4: the teacher states how to carry out laboratory experiments to determine the chemical properties of fats alkaline hydrolysis of oil (Saponification)

Alkaline hydrolysis of fats (Saponification); Saponification is the alkaline hydrolysis of fats and oils. It is the process of making soap. The fat and oils is hydrolysed with either sodium hydroxide solution or potassium soap of fatty acid (soft soap). Propan- 1,2,3 – triol (glycerol) is also formed as bye produce.

Fats or Oil in caustic alkali $\rightarrow$ Soap + Propan – 1,2,3 – triol

Evaluation: the teacher evaluates the students learning outcome by asking them the following questions

Questions.

a. Identify the reagents and apparatus use during the production of fats

b. Carry out laboratory preparation of fats

c. Carry out laboratory experiments to determine the boiling point and melting points of fats.

d. Carry out laboratory test for the presence of fats.

e. Carry out laboratory experiments to determine the chemical properties of fats.

Summary: The teacher summarizes the main points of the lesson as follows.

Fats are solids, usually of animal origin. Pure fats and oils are colorless almost white and odorless, they do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Differences between fats and oil

Fats are less saturated while oils are more saturated.

Fats are solids usually of animal origin while oils are liquids usually from plants.

Chemical properties of Fats and Oils

Alkaline hydrolysis of fats (saponification);

Saponification is the alkaline hydrolysis of fats and oils. It is the process of making soap.

Conclusion: The teacher concludes the lesson by allowing students to ask relevant Questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Isah Kaita College of Education dutsenma Katsina State.

Level : N.C.E II

Age Range : 20 – 25 years

Topic : Saponification

Sub-Topic : Laboratory preparation of Soaps

Lesson: 4

Week: 4

Date : 30th February 2015

Time: 4: 00 – 6: 00 pm

Duration: 2 hours

Instructional Materials: palm Oil, NaOH solution, saturated sodium chloride solution (brine) Water.

Concepts in the Lesson: laboratory preparation of soap, cleansing action of soap, similarities between soaps and detergents, advantage of soap over detergent.

Behavioural objectives: By the end of the lesson the students' should be able to:

i. Carry out preparation of soap.
ii. Write equations for the laboratory preparation of soap.
iii. State the similarities between soaps and detergents
iv. State 2- similarities and differences between soaps and detergents.

Rationale: Soaps are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are familiar with the following concepts;

- Fats and Oils,
- Physical and Chemical Properties of Fats and Oils
- Differences between Fats and Oils.

Introduction: The teacher introduces the lesson by asking students questions based on their previous knowledge as follows:

Questions

1: Define fats and oils.

Students respond by defining fats and oils as esters of long chain fatty acids and propan-1,2,3-triol.

2: State the physical properties of fats and oils.

Students respond by stating the physical properties of fats and oils as

- Fats and oils are colourless almost white and odourless which is due to the presence of small quantity of non – fatty substances
- They do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters)
- They are insoluble in water but soluble in organic compounds such as alcohols

Presentation: The teacher presents the lesson according to the following steps

Step 1: Teacher states how Soaps are prepared.

preparation of soap

Soaps are prepare by boiling palm oil in a beaker. Add NaOH solution to it, stir carefully during the addition. Continue to boil and stir until the oil layer disappears. Allow to cool add about saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

Step2; The teacher states the similarities and difference between soaps and detergents.

The similarities between soaps and detergents are;

They are both cleansing agents,

They are both synthesised from fats and oils,

They all contain Alkyl groups,

The differences between soaps and detergents are;

Soap is sodium or potassium salt of a long chain carboxylic acid, while detergent is sodium or potassium salt of long chain Alkyl hydrogentetraoxosulphate (IV),

Soap can be represented by the general formulae $R\text{-}CO_2Na$, while detergents can be represented by $R\text{-}OSO^-_3Na^+$

Soap has a long non-polar alkylgroup R, while detergent has a long non-polar alkylgroup R, and a polar group $OSO^-_3Na^+$ which is responsible for their cleansing properties.

Soap produces dirty-white scum in hard water because their calcium and magnesium salts are water soluble.

Step3: Teacher states the advantages of soaps over detergents as the teacher guides them.

Advantages of Soap over Detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable and

Evaluation: the teacher evaluates the students by asking them questions based on what was taught during the lesson.

Questions.

a. Carry out preparation of soap.

b. Write equations for the laboratory preparation of soap.

c. State two advantages of soaps over detergents.

d. State 2 similarities and differences between soaps and detergents.

Summary: The teacher summarizes the lesson by re-explaining the key points in the lesson.

Boil about $5cm^3$ of palm oil in a beaker. Add $25cm^3$ of 2M NaOH solution to it, stirring during the addition. Continue to boil and stir until the oil layer disappears. Allow to cool add about $25cm^3$ of saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

Advantages of Soap over Detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable and

Conclusion; the teacher concludes the lesson by allowing students to ask questions

Name of School: Isah Kaita College of Education Dutsenma.

Level: N.C.E II

Age Range: 20 – 25 years

Topic: Saponification

Sub-Topic: Laboratory preparation of Detergents

Lesson: 5

Week: 5

Date: 5th February 2015

Time: 4:00- 6: 00 pm

Duration: 2 hours

Instructional Materials: sodium, ethanol, Conc H_2SO_4, dilute NaOH, Beaker, Burner, Stirrer, Ovum, measuring cylinder..

Concepts in the Lesson: Laboratory Preparation of Detergents, Advantage of Detergent over Soap, Similarities between Soaps and Detergents.

Behavioural Objectives: By the end of the lesson the students' should be able to

a. Perform laboratory preparation of detergent

b. Write equations for the laboratory preparation of detergent.

c. State 2-similarities and differences between soaps and detergents.

Rationale: Detergents are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are familiar with the following concepts;

- How to prepare soap in the laboratory
- Equations for the Laboratory preparation of soap
- Advantages of Soaps over Detergents

Introduction: The teacher introduces the lesson by asking students questions based on their previous Knowledge as follows:

Questions

i. State the reagents required for the preparation of Soaps

Students respond by stating the following reagents use during laboratory preparation of Soaps: palm oil, NaOH solution, sodium chloride solution (brine), water.

ii. States how Soaps are prepared in the Laboratory

Students respond by stating how soaps are prepared in the laboratory as follows

Laboratory preparation of soap

Soaps are prepared in the Laboratory by boiling palm oil in a beaker. Add NaOH solution to it, stir carefully during the addition. Continue to boil and stir until the oil layer disappears. Allow to cool add about saturated sodium chloride solution (brine) to reduce the solubility of the soap so that it separates out a white solution. Decant the liquid (which contain propan – 1,2,3 – triol), wash the solid soap with more brine and then with a little water.

iii State two Advantage of soaps over detergents

Students respond by stating advantage of soaps over detergents as follows:

Advantages of Soap over Detergents

Soap does not cause water pollution because it is biodegradable i.e. it can be easily decomposed by bacteria into simple inorganic substances. But, certain detergents are non-biodegradable and

Presentation: the teacher presents the lesson according to the following steps

Step 1; Teacher states the reagents and apparatus required for the preparation of detergents as follows sodium, ethanol, conc H_2SO_4, dilute NaOH.

Apparatus required for the laboratory preparation of detergents are; beaker, burner, stirrer, ovum, measuring cylinder.

Step 2; Teacher explains how detergents are being prepared in the laboratory from fatty acids,

From fatty acids: - Synthetic detergents are obtained from long chain mono carboxylic fatty acids as follows. The fatty acid is reduced by sodium in ethanol to give fatty ethanol.

$CH_3(CH_2)_{16}COOH + 2[H] \longrightarrow CH_3(CH_2)_{16}CH_2OH$

The alcohol is then treated with Conc H_2SO_4 in ratio 1:1 to give the Alkylhydrogentetraoxosulphate (VI).The Alkylhydrogentetrasulpahte (VI) (acidic) is neutralised with dilute NaOH or KOH solution to obtain the detergent.

$CH_3CH_2)_{16}CH_2\text{-}OSO_3H + NaOH \longrightarrow CH_3(CH_2)_{16}CH_2\text{-}OSO_3H + H_2O.$

They are represented by the general formulae R-OSO3N(A). The R- represents the straight chain carbon atoms which make detergents biodegradable and bring about foaming in river

Step 3: The teacher states the similarities and difference between Soaps and Detergents.

Similarities between soaps and detergents

They are both cleansing agents.

They are both synthesised from fats and oils.

They all contain Alkyl groups.

Differences between soaps and detergents

- Soap is sodium or potassium salt of a long chain carboxylic acid, while detergent is sodium or potassium salt of long chain Alkyl hydrogentetraoxosulphate (IV),
- Soap can be represented by the general formulae $R\text{-}CO_2Na$, while detergents can be represented by the formulae $R\text{-}OSO^-_3Na^+$
- Soap has a long non-polar alkylgroup R, while detergent has a long non-polar alkylgroup R, and a polar group $OSO^-_3Na^+$ which is responsible for their cleansing properties
- Soap produces dirty-white scum in hard water because their calcium and magnesium salts are water soluble.

Step 4: Teacher states the advantages of detergents over soaps as follows

Advantages of Detergents over Soap

- Unlike soap detergents retain their cleansing property irrespective of water used
- They neither form cum in hard water nor react with hydrogen ion in acidic water.
- Detergents have a wider application than soap because they can be tailor-made for specific purposes.

Evaluation: The teacher evaluates the students by asking them questions based on what was taught during the lesson.

Questions.

a. Carry out laboratory preparation of detergents.

b. Write equations for the laboratory preparation of detergents.

c. State 2-advantages of soaps over detergents

d. State 2 similarities and differences between soaps and detergents.

Summary: The teacher summarizes the lesson by re explaining the key points in the lesson.

Laboratory preparation of Detergents

Synthetic detergents are obtained from long chain mono carboxylic fatty acids as follows. The fatty acid is reduced by sodium in ethanol to give fatty ethanol.

$CH_3(CH_2)_{16}COOH + 2[H] \longrightarrow CH_3(CH_2)_{16}CH_2OH$

The alcohol is then treated with Conc H_2SO_4 in ratio 1:1 to give the Alkylhydrogentetraoxosulphate (VI).The Alkylhydrogentetrasulpahte (VI) (acidic) is neutralised with dilute NaOH or KOH solution to obtain the detergent.

$CH_3CH_2)_{16}CH_2\text{-}OSO_3H + NaOH \longrightarrow CH_3(CH_2)_{16}CH_2\text{-}OSO_3H + H_2O.$

They are represented by the general formulae $R\text{-}OSO_3Na$. The R- represents the straight chain carbon atoms which make detergents biodegradable and bring about foaming in river

Advantages of Detergents over Soap

Unlike soap detergents retain their cleansing property irrespective of water used. They neither form cum in hard water nor react with hydrogen ion in acidic water. Besides, detergents have a wider application than soap because they can be tailor-made for specific purposes.

Conclusion; the teacher concludes the lesson by allowing students to ask questions

Name of the Teacher: Hadiza Muhammad- Lawal

Registration Numbers: M.ed/Educ/1539/20011-2012

Name of School: Isah Kaita College of Education Dustenma Katsina .

Level : N.C.E II

Age Range : 20 – 25 years

Topic : Saponification

Sub-Topic : Liquid Soap Production

Lesson: 6

Week: 6

Date: 12th February 2015

Time: 4:00- 6 : 00 pm

Duration: 2 hours

Instructional Materials: Soda Ash, Sodium, chlorine, sulphate, Colorant, Perfume (fragrance), Alkyl benzene sulphonic acid, Antisal(starch), Caustic soda, Soda Ash, stirrer and containers

Concepts in the Lesson: Production of liquid soap

Behavioral objectives: By the end of the lesson the students' should be able to identify

a. Identify the reagents use for the production of Liquid Soap.

b. Identify the uses of each reagent use during Liquid Soap Production.

c. Produce Liquid Soap

Rationale: soaps are important aspect of life in that it is effective in getting rid of dirt and germs and good cleaning agents which are of domestically importance.

Previous knowledge: Students are Familiar with the Following Concepts;

Fats and oils

-The physical and chemical properties of fats and oils

-Test for the presence of fats and oils in a compound

Introduction: The teacher introduces the lesson by asking the students the following questions

Questions.

a. Define fats and oils.

Students Respond: Fats and oils are higher alkanoates. They are esters of long chain fatty acids and propan-1, 2, 3-triol

State the physical and chemical properties of fats and oils.

Students Respond: students respond by stating the Physical and Chemical Properties of Fats and Oils as follows

Physical Properties;

Pure fats and oils are colorless almost white and odorless which is due to the presence of small quantity of non – fatty substances

They do not have sharp melting and boiling points because they are complex mixture of two or more different triglycerides (esters).

Chemical Properties

Hydrogenation of vegetable oils (production of margarine); oils are converted in to fats by hydrogenation .this is done by bubbling hydrogen into the oil at about 5atm and temperature of 180^0C in the presence of finely divided Nickle as a catalyst until the product is fairly hardened. Milk, common salts, vitamins A and B are then added.

$$Fats/Oils + H_2 \xrightarrow{Nickel/5atm/180^0C} Margarine.$$

Alkaline hydrolysis of fats (Saponification); Saponification is the alkaline hydrolysis of fats and oils. It is the process of making soap. The fat and oils is hydrolysed with either sodium hydroxide solution or potassium soap of fatty acid (soft soap). Propan- 1,2,3 – triol (glycerol) is also formed as bye produce.

Fats or Oil in caustic alkali $\rightarrow$ Soap + Propan – 1,2,3 – triol

a. Describe a test to identify the presence of fats and oils in a compound.

Students Respond. The students respond by describe a test to identify the presence of fats and oils in a compound as follows

Test for the presence of fats and oils

Test	Observation	Inference
Shake 5cm of the unknown substance with water and then add 4 to 5 drops of Sudan III reagent	red stain appears	The substance is a fat or oil

Presentation: The teacher presents the Lesson according to the following steps

Step 1; The teacher states the reagents and apparatus needed for the production of Liquid soap.

Reagents for production Liquid soap: Antisal (starch)/Nitrosol, Caustic Soda, Soda Ash, Sodium thio Sulphate, CitricAcid, Colorant, Perfume (fragrance),Alkyl benzene Sulphonic acid and water.

Apparatus for liquid Soap Production; 25 liters bowl, stearing stick, hydrometer, weigh balance

Step 2; the teacher states the use of each reagent and apparatus use during Liquid Soap Production.

Uses of reagents and apparatus use during Liquid Soap Production

a. Antisal (starch): It serves as a thickner because its thicken the liquid soap.
b. Caustic soda (NaOH): Hydrolyze fat and oil to give propane 1,2,3-triol and soap. It is also a stain remover.
c. Soda Ash: It helps in regulating caustic soda.
d. Sodium thio sulphate: It is a foaming agent.
e. Color: It gives the liquid soap color
f. Water to make the soap Liquid.
g. Perfume: It produces fragrance /Scent.
h. Alkyl Benzene Sulphonic Acid: It is also a foaming agent.
i. Citric acid provide vitamins to protect your skin
j. Hydrometer to measure the acidity of both the caustic soda and soda ash.
k. Weigh balance. To weigh the reagents used

Step 3; the teacher use the weighing balance to measure required amount of reagents used during the liquid soap production process while the students' watch.

Nitrosol 1/4kg

Caustic Soda 1/4kg

Soda Ash 1/2kg

Sodium thio Sulphate

CitricAcid 100grm

Colorant 1kg

Perfume (fragrance) 10cm

Sulphonic acid 1lit

Water 25lit

Step 4 ; the teacher carry out the production of Liquid soap while the students' watch.

The teacher Pour water in to a wide bowl and then add the Nitrosol and stir for 5minutes when the solution thickness add soda ash and stir for 5minutes,add Sulphonic acid and srir for 10minures, add sodium thio sulpate and stir for 3minutes, add caustic soda and stir at this point the student insert the hydrometer in to the solution to measure the concentration of both the caustic soda and the soda ash. The required value for the concentration is 1275 for caustic soda and 1250 for the sodaash then, add citric acid to the solution and stir for 3minutes, add perfume and colour then stir for 10minutes.

Note; the stirring is to be in one direction so as to get a good finished product.

Evaluation: the teacher evaluates students learning out come by asking the following questions The teacher issue a liquid soap production manual to the students and evaluates the students learning outcome by asking them to Produce Liquid Soap and use the observation check List to evaluate their skills and ask the following questions.

a. Identify the reagents use for the production of Liquid Soap.

b. Identify the uses of each reagent use during Liquid Soap Production.

c. Produce Liquid Soap

Summary ; the teacher summarizes the main points of the lesson

Reagents for production Liquid soap: Antisal (starch)/Nitrosol, Caustic Soda, Soda Ash, Sodium thio Sulphate, CitricAcid, Colorant, Perfume (fragrance),Alkyl benzene Sulphonic acid and water.

Apparatus for liquid Soap Production; 25 liters bowl, steering stick, hydrometer, weigh balance.

Liquid soap is prepared as follows;

Pour the water in to a wide bowl and then add the Nitrosol and stir for 5minutes when the solution thickness add soda ash and stir for 5 minutes, add Sulphonic acid and srir for 10 minures, add sodium thio sulpate and stir for 3 minutes, add caustic soda and stir at this point insert the hydrometer in to the solution to measure the concentration of both the caustic soda and the soda ash. The required value for the concentration is 1275 for caustic soda and 1250 for the soda ash. Then, add citric acid to the solution and stir for 3minutes, add perfume and colour then stir for 10minutes.

Conclusion; the teacher concludes the lesson by allowing students ask questions based on what they were taught during the lesson.

APPENDIX F

LIQUID SOAP PRODUCTION MANUAL

REAGENTS NEEDED FOR LIQUID SOAP PRODUCTION

SodaAsh, Sodiumchloride, sulphate, colorant, perfume (fragrance), Alkyl benzene sulphonic acid, Nitrosol, Caustic soda.

Step1; prepare Nitrosol salt suspension by adding water to the powder and allow to stay for 1hour for effective dissolution

Step2; measure 25 litres of clean water and pour into a clean plastic bucket

Step3; weigh 63.6g of Antisal (starch) and add into the water then stir for about 4 to 5 minutes using a clean dry wooden stick.

Step4; allow the mixture to stay and soak and steer regularly.

Step5; weigh 54.98g caustic soda and dissolve into about 20cm^3 of clean water then keep the mixture aside.

Then weigh 109.41g of soda Ash and dissolve into about 20cm^3 of clean water.

-weigh 33.43g of sodium chlorine and dissolve into about 20cm^3 of clean water.

-weigh sulphate and dissolve into about 20cm^3 of clean water.

Step6; add the solutions in step 4 to the mixture in step3 in the following order;

add solution of caustic soda followed by solution of soda ash then solution of sodium chlorosulphate. Stir the mixture of the salt solutions for about 2 minutes in a clockwise direction.

Step7; transfer the mixture in step5 into the container containing the Nitrosol salt suspension stirrer for 30 minutes for the mixture to dissolve properly.

Step8; weigh 5.0g of colorant reagent and add to the mixture.

Step9; add 2ml of perfume to improve the quality and scent of the liquid soap.

Step10; add 20ml of alkyl benzene sulphonic acid solution to the mixture and stir in a clockwise direction for about 3 minutes.

Step11; finally, cover the mixture and allow staying for an hour to ensure complete reactions and formation of high foam.

APPENDIX G

ITEMS ANALYSIS

No	Item difficulty index: $P = \frac{R}{T} \times 100\%$	$item\ discrimination\ index: D = \frac{Ru - RL}{N}$	Decision
1	0.41	0.43	Retained
2	50	0.45	Retained
3	55	0.43	Retained
4	44	0.41	Retained
5	39	0.29	Modified and Retained
6	40	0.39	Modified and Retained
7	41	0.48	Retained
8	41	0.42	Retained
9	38	0.31	Modified and Retained
10	29	0.29	Modified and Retained
11	29	0.28	Modified and Retained
12	42	0.35	Retained
13	29	0.29	Modified and Retained
14	41	0.45	Retained
15	40	0.42	Retained
16	61	0.48	Retained
17	40	0.53	Retained
18	21	0.31	Modified and Retained
19	31	0.29	Modified and Retained
20	40	$0.52M$	Retained
21	21	0.29	Modified and Retained
22	40	0.42	Retained
23	42	0.58	Retained
24	46	0.70	Retained
25	39	0.31	Retained
26	41	0.53	Retained
27	46	0.51	Retained
28	48	0.48	Retained
29	46	0.50	Retained

30	44	0.50	Retained
31	51	0.50	Retained
32	45	0.44	Retained
33	50	0.43	Retained
34	39	0.45	Retained
35	44	0.45	Retained
36	46	0.42	Retained
37	44	0.48	Retained
38	58	0.53	Retained
39	44	0.57	Retained
40	41	0.47	Retained
41	48	0.48	Retained
42	21	0.29	Retained
43	53	0.53	Retained
44	48	0.48	Retained
45	38	0.37	Retained
46	45	0.43	Retained
47	36	0.50	Retained
48	41	0.41	Retained
49	47	0.47	Retained
50	28	0.32	Modified and Retained

APPENDIX H

ANOVA

	Sum of squares	Df	Mean Square	F	Sig.
Between Groups	1671.697	9	185.744	2.160	0.029
Within Groups	24933.700	290	85.978		
Total	26605.397	299			