USMANU DANFODIYO UNIVERSITY, SOKOTO
(POSTGRADUATE SCHOOL)

EFFECTS OF LABORATORY EXERCISES ON SCIENCE SECONDARY SCHOOL STUDENTS' PERFORMANCE IN CHEMISTRY, IN KADUNA STATE, NIGERIA

A Dissertation
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DEDICATION

This project is dedicated to my parents, wife and children for their prayers to God for His guidance and protection throughout the years of my study.

CERTIFICATION

This Dissertation by BONAH, Ibrahim Yero (09/211404007) has met the requirement for the award of the Degree of Master of Education in Science Education of Usmanu Danfodiyo University, Sokoto, and is approved for its contribution to knowledge.

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ABSTRACT

This research work investigated the effects of laboratory exercises on science secondary school students' performance in chemistry, in Kaduna State, Nigeria. In most of the literature reviewed, the final outcome favoured laboratory exercises. Quasi experimental and descriptive survey research were employed in this study. In quasi experimental design the researcher selected six (6) schools out of 372 science schools across the state. Similarly, 31 schools were selected for survey research, questionnaire was used to collect data. The six sample schools are from the central educational zone selected through stratified sampling technique. Four research questions and two hypotheses were formulated in conformity with the stated objectives. The reliability of the twenty test items were obtained through pilot study, using Pearson Product Moment Correlation Co-efficient r=0.78. While Cronbach Alpha was used to test the reliability of the questionnaire r=0.55. The two null hypotheses were analyzed using T-test with $\alpha = 0.05$. The researcher recommended among others that, chemistry teachers should see laboratory exercises as a need that cannot be avoided.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Laboratory is a focal point for all scientific activities. It is usually equipped with tools that facilitate effective teaching and learning of science. Science is experimental in nature and the laboratory helps to enhance scientific knowledge through the process of science (observing, classifying, measuring and interaction with objects and events of scientific interest). Abdullahi, (1982), emphasizes that science is not science unless it is accompanied by laboratory exercises i.e putting theories into practice. Laboratory provides ideal setting for skill development, discovery learning, inquiry and problem solving activities. Laboratory work is a range of activities from true experimental investigation to confirmatory exercises and skill acquisition. Since science is experimental in nature, any course in science should reflect this by introducing laboratory work. This is because, it is in the laboratory that learners learn science through precise measurement, accurate observation and clarity in Communication (Muhammad, 2010).

Laboratory work is an established part of chemistry at all levels of education. The original reasons for its development lay in the need to produce skilled technicians for the industry and highly competent workers for research laboratories (Morrell, 1972). There is need to prepare students practically in the laboratory as well as develop some follow-up activities.

These may enrich and enhance the whole laboratory experience and enable it to contribute more effectively to the overall learning of students in chemistry. It would be rare to find out any science course in any institution of education without a substantial component of laboratory activity. However, it is taken for granted that experimental work is a fundamental part of any science course and this is especially true for chemistry courses. Very frequently, it is asserted that chemistry is a practical subject and this is assumed, some what naively to offer adequate justification for the presence of laboratory work. Thus, the development of experimental skills among the students is often a suggested justification.

One of the main reasons to question the place of laboratory in science teaching is that, laboratory programmes are very expansive in terms of facilities and material resources, but also, more importantly in terms of staff-time (Carnduff & Reid, 2003). Laboratory work is used to describe the practical activities which students undertake using chemicals and equipments in chemistry laboratory. The word “practical” can include other experimental activities conducted in the laboratory by students. Laboratory classes are where science students acquire and practice key manipulative and process skills while learning to move concepts from an abstract into a concrete setting (O’ Brien & Cameron, 2008).

West African Examinations Council (WAEC) and National Examinations Council (NECO) on the other hand, being the highest examination bodies for Senior secondary school students in Nigeria recommended that the teaching of all science subjects listed in their syllabi should be practical based (WAEC, 2008). This perhaps is to demonstrate the importance they attached to practical work in science.

Chemistry laboratory gives students an opportunity to handle equipment and chemicals, to learn about safety procedures, to master specific techniques, to measure accurately and to observe carefully. However, making chemistry real and exposing ideas to empirical test is of great importance. Skills of observation, deduction and interpretation are also very important. In addition, there are many other important practical skills to be developed such as team-work, reporting, presenting and, developing ways to solve practical problems. Many school courses seek to develop some of these outcomes to help students learn science through the wise use of properly designed and utilize school laboratories for students to think scientifically. No matter how good a student is, without learning materials and effective methodology of teaching from his teacher may eventually lead him/her to low performance in chemistry. It is possible to adopt laboratory method of teaching chemistry in order to enhance students performance. This is because, laboratory teaching technique encourage students to take more active role in their learning, it also create enthusiasm and creativity in students (Carnduff & Reid, 2003).

The researcher is fully aware of other variables that could influence students academic performance, like teacher's qualification and adequacy, effectiveness, availability of laboratory facilities, interest, leadership style e.t.c. towards the end of the twentieth century, more sophisticated alternatives had been introduced to facilitate effective learning in school laboratories. These include pre-laboratory experiences, films, video experiments, computer based pre-laboratories, post-laboratory exercises and computer simulations which can assist the students in Kaduna State to improve their performance in chemistry (Carnduff & Reid, 2003).

Inequalities in some instances down right deprivation have characterized the position of women both in education system and in the Nigerian society at large. “Deny, anybody education, you deny that human being freedom”. Women must be mobilized and motivated to seek education for themselves and their daughters. They must also be determined to get their daughters complete their study and to obtain reasonable and worth wide grades in their examinations (Shehu, 1995).

1.2 Statement of the Problem

Students performance in chemistry at the Senior Secondary Certificate Examination (SSCE) WAEC in Kaduna state science schools, keep fluctuating. For example, students that obtained credit pass in chemistry from Government College Kaduna in 2010 was 62%, 79%, in 2011, 38% in 2012 and 57% in 2013. Schools with similar problems are; Jupavi, Government Day Secondary school Sabon-Tasha, Girls Science School Kwoi, just to mention but few. (Ministry of education, Kaduna State, 2014). There are so many factors that hinder the effective use of laboratory exercises in teaching chemistry in the state. Such as; teachers work load, lack of equipments and materials, lack of incentives, lack of laboratory assistant, it is time consuming, and lack of exposure of students to laboratory exercises which affect their performance directly.

Practical covers 40% of the total score, and students can hardly conduct these practical because they lack the basis and confidence to conduct such practical, which affect their performance in Senior Secondary Certificate Examination.

Science teachers do not always find it convenient to make laboratory work the center of their instruction, as the condition under which many teachers operate does not engender enthusiasm to use the laboratory method of teaching chemistry, even where material and equipments are available. The workload and class size may be discouraging (Ministry of Education, Kaduna State, 2014).

1.3 Objectives of the Study

The objectives of this study are to find out;

1. the level of exposure of secondary school students to chemistry laboratory exercises in Kaduna state.
2. the factors that hinder effective use of laboratory exercises in teaching chemistry in Kaduna state
3. the difference in the performance of students that are exposed to chemistry laboratory exercises and those that are not.
4. the difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises.

1.4 Research Questions

The following research questions are raised to guide this study.

1. What is the level of exposure to chemistry laboratory exercises among secondary school students in Kaduna State?
2. What are the factors that hinder the effective use of laboratory exercises in teaching chemistry to secondary school students in Kaduna State?
3. Is there any difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not?

4. Is there any difference in the performance of male and female students exposed to chemistry laboratory exercises?

1.5 Null Hypotheses

The following null hypotheses are formulated and tested at $\alpha=0.05$ level of significance

1. There is no significant difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not.
2. There is no significant difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises.

1.6 Significance of the Study

The findings in this study will be significant to all science educators and students, because it would help to remind them of the role accorded to practical work in science. It would also remind school administrators/teachers of the need to adhere to WAEC/NECO recommendations in their syllabi, by equipping students practically before their final exams. It would also show the effect of laboratory exercises on students performances in chemistry. A well designed science laboratory if prudently used would enable students to learn the product of science, posses skills of the scientists and develop scientific attitudes, hence this can enhance their performance.

1.7 Scope and Delimitation of the Study

The study is delimited to Science Secondary Schools Students in Kaduna State that are offering chemistry. SS2 students are the targeted population, because they have covered a lot of their course work in chemistry and they know if practical are conducted in their respective schools or not. The research is also delimited to the following topics: volumetric analysis, test for ammonium ion and separating funnel technique.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter the definition and historical perspective of science laboratory, origin of experimental science, importance of laboratory work in secondary schools, effective design of laboratory learning exercises, equity and science learning, improvisation of laboratory equipments, safety in laboratory, Review of Empirical study, Summary and uniqueness of the study are reported. The chapter is organized along the following sections

2.2 Definition and Historical Perspective of Science Laboratory

2.3 Origin of Experimental Science

2.4 Importance of Laboratory work in Secondary Schools

2.5 Effective Design of Laboratory Learning Exercises

2.6 Gender in Science Learning

2.7 Improvisation of Laboratory Equipments

2.8 Science Teaching Method

2.9 Safety in Laboratory

2.10 Review of Empirical Studies

2.11 Summary and Uniqueness of the Study

2.2 Definition and Historical Perspective of Science Laboratory

Science teaching especially in senior secondary schools in Nigeria is mostly conducted within a special accommodation called the school laboratory. Laboratory is a focal point for all scientific activities. Laboratory work is an established part of courses in science both in secondary and higher education. Muhammad (2010), defined science laboratory as an instructional facility that helps pupils to learn what science is and how scientists work.

There are several locations in and around the school which could serve as means of helping students learn science. In its broadest sense, such locations are considered to be laboratory facilities that provide meaningful science learning experiences. These locations include: A nearby school garden, a carpenter/blacksmith/mechanic workshop, pond, railway station, hospitals e.t.c these locations provide direct science learning experiences to the students by bringing them face to face with the concrete objects and happenings, these locations are more suitable for learning science.

Based on Mohammad's (2010) definition, two types of laboratory can be identified:

1. Indoor laboratory: Suitable place specifically designed, organized and managed for scientific investigation.
2. Outdoor laboratory: Suitable place used for scientific investigations outside the classroom e.g Farm, river, stream, mechanic workshop e.t.c

The first teaching laboratory in chemistry was established in Britain by Thomas Thomsons in the University of Edinburgh in 1807. In 1819, he introduced similar laboratory work to the University of Glasgow when he joined this University. In 1824 Liebig established a chemistry laboratory at the University of Geissen, this was the most exciting period of the nineteenth century. Liebig's was the first institutional laboratory in which students were deliberately trained for membership of a highly effective research school by means of systematic research experiments (Morrell, 1969).

Laboratory classes then gradually developed over the next fifty years until eventually, in 1899, it came to be considered necessary that school pupils be allowed to carry out experiments for themselves. By this time, however, most schools in England had already adopted this way and regarded practical work as an essential requirement for science teaching (Gee & Clackson, 1992). Thus, practical training in chemistry sprang up in universities all over Europe and North America. These were devoted to the teaching of skill directly used in industries and research (Letton, 1987). Practical work at this time played a vital role in confirming the theory which was already taught in the classroom. A century ago Armstrong advocated direct experimentation by the pupils rather than demonstration experiments performed by the teacher (Hadson, 1990). Therefore attention switched back once again to teacher demonstration. Towards the end of the twentieth century, more sophisticated alternatives had been introduced to facilitate the effective learning in school laboratories. These include: pre-laboratory experiences films, video experiments, computer based pre-laboratories, post-laboratory exercises and computer simulations (Carnduff & Reid, 2003).

Benneth and O'Neale (1998), proposed guide for the design of laboratory course in chemistry in higher education in terms of the "logical sequence" of ideas, "opportunity for real investigations very early in the course" and pre and post-laboratory sessions which actively engage the students". These principles reflect the ideas of Dennins Diberot, the French philosopher, who outlined three principal means of acquiring knowledge available to us. Observation of nature, reflection and experimentation. Observation collect facts; reflection combines those facts; experimentation verifies the results of the combination. All of these illustrate the need to decide what the aims are for using laboratory work in teaching chemistry in the educational system. Therefore, the researcher need to go round the selected schools to observed there laboratories, those facts that he gather should be combine to verified the result.

2.3 Origin of Experimental Science

The use of laboratory method in science teaching originated from the ideas of early scientists. The 17th century is very significant in this respect, Mendelson (1982), characterized the century as the century of “the scientific revolution”. This characterization is so because according to Westfall (1971). “It was in the 17th century that the experimental methods become a widely employed tool of scientific investigation”. (P.115).

Taylor (1963), claimed that “the idea of experimental science began to have influence in about 1590”. (P.90). When scientists started basing their work on deliberately contrived experiments. According to him “Galileo Galilei (1564-1643) was the first to employ the scientific method in the fullness” (P.91) in physics and astronomy.

However, it was in the 17th century that scientists paid greatest attention to the scientific method that led to a revolution in science. The sheer number of persons that paid attention to methods then indicated the need for an acceptable method of conducting experiment in science. Francis Bacon (1561-1626) was perhaps the first in the 17th century to formulate a series of steps to account for the scientific methods in his book Novum Organum (Taylor, 1963). The book was a reaction to Aristotle’s treatise in logic referred to as Organum. Bacon based his method on the inductive method of objective observation and experimentation without any preconceptions. Westfall, (1971), credited Robert Boyle with perhaps the best statement of the experimental method that focused on “the activity of investigation that distinguishes the experimental method of modern science from logic” (P. 115). The emphasis on method during this period paid off with the several discoveries and inventions in the 17th century and beyond, thereby giving the impression, that science is synonymous with its method.

2.4 Importance of Laboratory Work in Secondary Schools

Chemistry laboratory work here is used to describe the practical activities, which students undertake using chemicals and equipment. Thus Boud, et al., (1986) stress that, when planning a course, it is important to state clearly the course aims, goal and objectives. What is to be taught, who is to be taught, by what means and most importantly, what are the intended outputs?

Carnduff & Reid (2003) went on to provide a set of possible reasons for the inclusion of practical work in secondary school courses in chemistry as followed:

- Illustrating key concepts
- Seeing things for ‘real’
- Introducing equipment
- Training in specific practical skills and safety
- Teaching experimental design
- Developing observational skills
- Developing deduction and interpretation skills
- Developing team working skills

- Showing how theory arises form experimentation
- Reporting, presenting, data analysis and discussion
- Developing time management skills
- Enhancing motivation and building confidence
- Developing problem solving skills

The development of powers of observation, measurement, prediction, interpretation, designing of experiments are dependent on laboratory work. However, laboratories at secondary level do not seem to play their role very well to gain these goals and objectives (Carnduff & Reid, 2003). There may be a major need to change or improve the present situation to create more opportunity for the students to fulfill these objectives.

Lack of clear sense of purpose in the design of laboratory courses is another factor which emphasizes the need for review and change. Infact, secondary school teachers concentrate on the experiments to be performed by the students and on the time available, rather than on the educationally best way to achieve their teaching aims, although all the evidence that they need to improve practical teaching is easily available. This pinpoints the root of the problem: too much emphasis on the experiments to be performed and not enough emphasis on what the students should be gaining. It asserts that all the evidence to improve practical teaching is easily available.

The important issue is that school teacher needs to decide which skills are to be developed in a particular laboratory course, to set these out in clear, unambiguous terms for the students, and to ensure that the whole design of the laboratory experience is consistent with specified skills.

The conventional way of preparing students would be to encourage them to read their laboratory course manual, but these manuals need to be re-written with simplicity in mind, if it is desired that students do not use them as ‘cookbooks’ Johnstone & Letton, (1990). Below are the importance of science laboratory work.

Shulman & Tamir (1973) identified three rationales generally advanced by those that supported the use of laboratory in science teaching thus:

i) The subject matter in science is highly complex and abstract

ii) Students need to participate in enquiry to appreciate the spirit and methods of science, and

iii) Practical work is intrinsically interesting to students

Shulman & Tamir (1973), also compiled a list of objectives of using laboratory work in science teaching. The list includes the teaching and learning of skills, concept, attitudes, cognitive abilities and understanding the nature of science. Also, there is hardly any science course that do not usually list the objectives of science laboratory work (Collette & Chiappetta, 1984).

Carnduff & Reid, (2003), outline the need for laboratory work in chemistry education in three broad areas.

(i) Practical skill (including safety, hazards, risk assessment procedures, instruments, observation of methods).

(ii) Transferable skills (including team work, organization, time management, communication, presentation, information retrieval, data processing numeracy, designing strategies, problem solving, and

(iii) Intellectual stimulation: Connections with the ‘real world”, raising enthusiasm for chemistry.

The making of chemistry real is also stressed and the absence of laboratory course would make this very difficult to attain.

All science curricula in Nigeria list practical activities that should go with each curriculum item listed. The current WAEC (2008) and NECO (2008) syllabi recommended that the teaching of all science subjects listed in their syllabi should be practical based, perhaps, to demonstrate the importance they attached to practical work in science. Thus, several decades of emphasizing the importance of Laboratory work in science teaching have elevated the importance to the level of a dogma. Thomas (1972), though that science educators should treat laboratory work as the “meal” rather than an “extra” or the desert after a meal”. Also, Bajah (1984), said “All science teachers and students should know that practical work is the “gem” of science teaching (P.44). This importance of laboratory work originated from the view of some American educationists in the early sixties that extolled the importance of laboratory work in science teaching. Notable among these personalities are; Schwab (1960), “Brunner” (1961), and “Gagne”, (1963). They all extolled the virtues of teaching science as a process of inquiry or discovery. Before them, Dewey (1938) advocated learning by doing through his “project method” that he considered as a method of organizing the school curriculum on scientific basis. The ultimate goal of these advocates of practical work was to train students to become good scientists in the future. The surprise by which the former Soviet Union took the Americans and perhaps the world, in launching the sputnik into the space in 1957, motivated their position. Emphasis in science teaching at this time shifted from the products of science, to the processes of science i.e. how we teach and learn science (Bates, 1978).

According to Shulman and Tamir (1973), this shift in emphasis lacked empirical evidence, because the influence of these educationists mentioned above formed the basis of the shift. As a result of this influence, and the need to match the Soviet feat, the Americans commissioned and executed several curriculum development projects, which were all laboratory based, these curriculum development activities, with emphasis on laboratory work, spread to Nigeria and elsewhere in the world.

2.5 Effective Design of Laboratory Learning Exercises

To be effective, pre-laboratory preparation needs to be more than just an encouragement for students to read their manual before coming to class: pre-laboratory exercises must be designed as carefully as the practical manual itself (Johnstone & Al-Shuaili, 2006). Pre-laboratory exercises are essential form of guide to instruction. There is strong evidence that students learn more deeply through guided instructions than through discovery-based learning (Kirschner, et al., 2006). Example of such activity is worksheets which have been shown to have positive effects on student performance (Nadolski, et al., 2005). It leads to transfer of knowledge and problem-solving skills and guards against students acquiring misconceptions or disorganized knowledge (Kirschner, et al., 2006).

The pre-laboratory exercise can be used to do many things, although it is more or less impossible that it can do them all for any specific experiment. A pre-laboratory exercise may be able to:

1. Stimulate the students to think through the laboratory work
2. Encouragement students to recall or find information such as structures, equations, formulae, definitions, terminology, symbolism, physical properties, safety hazards or disposal procedures
3. Check that the experimental procedure has been read and understood. It can offer practice in data handling, drawings or calculations of the kind to be used in the write-up
4. Lead the students into thinking about the procedure or the concepts and may encourage the students to connect and revise prior knowledge, thus providing some reassurance about the topic.
5. Bridge the gap between laboratory and lectures, experiment and application (O' Brien & Cameroon, 2008).

The actual laboratory experience needs to be developed and changed. This is where the specification of clear aims and objectives can be helpful. For example, some laboratories can be developed that illustrate the chemistry being covered in lecture classes and make it real of the students. Thus, some synthetic organic chemistry may be covered, while in the inorganic area, the synthesis and study of the spectra of various metal complexes may be highly relevant. These various methods use in literature if full of papers describing all kinds of ingenious ways to make experimental work more interesting, relevant, safe and yet exciting (Carnduff & Reid, 2003).

The post-laboratory task can leads to an important aspect: what happens after the experimental work is completed in the laboratory? Very often the writing up of a report is seen by the students as pointless, particularly when it match the production of a ‘correct’ result. It is here that post-lab tasks can be invaluable, provided that they are designed to match the aims for the laboratory. Some of the ideas above implicitly involve post-lab tasks. Much can be built around discussion, looking for patterns in results and seeking to relate data obtained to underlying understandings in chemistry. This may involve a report or it may involve reaching a group conclusion. It may involve an application of a finding in a new situation, ideally, related to life outside the laboratory (Skryyabina, 2000).

The aim of post-lab task is to move laboratory experiences which stimulates and challenges, allowing students to see chemistry, as a science, at work. The conclusion can be summed up thus. “To change the experience, you don’t need to change the experiment, just what you do with it” (Carnduff & Reid, 2003).

The review of related literature is to exposed the researcher to research work that has been conducted in this topic. But what prompted this research work is yet the fluctuating nature of student’s performance in chemistry at SSCE level in Kaduna State.

Practical cover 40% of the total score in SSCE and if students have basis and confidence to conduct these practical exams, it will be easy to pass the exams. The rate of failure in public examination which persistently increased has attract the attention of many stakeholders. The believe is that no nation can develop scientifically and technologically without qualitative and quantitative educational system (Alao, 1990).

Bonwell & Esison (1999), affirmed that the problem of poor school performance was generally caused by poor method of teaching in schools. This prompted for this research work to strengthening and exploit other ways to remedy the situation.

2.6 Gender in Science Learning

In general, there is gender inequality in education in most countries of the world, with females being disadvantaged. In Africa the gender gap in education and hence in most areas of human endeavour is wide.

In recognition of this problem the Forum for African Women Educationists (FAWE) was founded in 1992. The goal of FAWE is to close the gender gap in education in Africa where women continue to lag behind men both in access to and continued participation in education.

A reason for low participation of women in science and poor performance in science education is an interaction between supply, demand and the learning process. Supply refers to the availability costs of schooling and religion, cultures, create the demand. The learning process involves the experiences that children have in school that are linked to the curriculum (Lockhead & Verspor, 1991). Disparities between groups arise for different reasons; one reason for the lower participation of girls is lack of demand, because of family and societal view about schooling for girls. Further more curriculum in adequacies and different treatment in the classroom of female students by both male and female teachers affect there performance.

Wasagu (2010), stress the need for equity in science, because there is a strong deep-seated tradition and conservative belief among key stakeholders in girls education. Such as parents, teachers, peers, policy-makers and even girls' themselves, that the study of Science, Mathematic and Technology (SMT) subject is only for boys and men.

They continue to consciously or unconsciously believe that girls lack the ability and determination to study and succeed in these “very difficult subjects’ Therefore, despite the lip service pay to the equality of girls and boys, many people including teachers, advise and actively discourage girls from studying science, mathematic and Technology subjects.

Moreover, the girls believe that even if the succeed in SMT, there are few opportunity for them and they are not likely to attain their full potential in what they perceive to be male-dominated professions.

Many teachers are not aware of gender issues in education and of the special difficulties that girls face in learning SMT. They are insensitive to the different out-of-school experiences that girls bring to the study of SMT and the fact that the current SMT content in most countries in Africa builds more on male than female experiences. They do not take account of the anxiety many girls experience when topics such as hygiene and reproduction are discussed, in the classroom or when girls are asked to use unfamiliar equipment and apparatus or live specimens. Teachers fail to understand when girls from traditional and conservative background, seem unwilling to enter discussions or ask questions, especially in mixed classrooms. The girls therefore appear less bright and capable than boys and end up performing badly and dropping out of SMT (Reddy, 1998).

2.7 Improvisation of Laboratory Equipments

Sometimes the apparatus required by the teacher may not be available. When the alternative is to make the item or apparatus ourselves, then the idea of improvising thus comes in. To improvise in science laboratory is simply to provide or make an alternative apparatus, which we do not have in stock. Muhammad (2010), defines improvisation as the act of using any product of similar or near similar to the actual instructional material in order to facilitate learning. i.e. creation of cheap and simple alternatives by the teacher or students and the careful selection of commonly available materials in order to made the teaching-learning process easier. It can also be view as the means of constructing or creation of cheap and simple alternatives by the teacher or students to make the teaching and learning process easier. The fact is that, in the absence of the actual instructional materials, an alternative to construct or made new one for used is what improvisation is all about. Other reasons for improvising teaching/learning material include;

i) To encourage creativity in teaching/learning situation

ii) To save cost.

Improvisation is vital in science teaching and learning, especially when materials and equipments in the laboratory are not adequate to meet the class size (Rothsak, 2013). Since experiment to be perform in the class, should be carried out by the students themselves and should take the form of "finding out" improvisation cannot be avoided by the teacher.

Opong (2014), reported that the best way to teach the skills and attitude of science in the laboratory based instruction is to give the learners an opportunity to practice these skills. These skills are not in-born but are developed and mastered through practice. It is in the laboratory that learners have the opportunity to practice science and acquire the right scientific skills and attitudes. Students who are privilege to conduct practicals adequately perform better in science achievement test (Katcha, 2013).

2.8 Science Teaching Method

The methods of science teaching instruction at the senior secondary schools have been widely criticized as being responsible for the undersirable state of science education in this country. The dominant teaching method of chalk and talk, show little concern for subject matter and method which would stimulate students interest. Jegede (1996), observed that the unsatisfactory performance of students in Science, reflects how well they understood science concepts. This confirmed Okeke, (1997), which reported that poor performance of students in science is as a result of poor teaching methods lack of incentives, teachers work load and lack of teaching materials. Supporting this view Njoko, (1987) indicate that poor preparations for teaching profession, defective and uninspiring teaching strategies are some of the factors responsible for students poor performance in the sciences.

2.9 Safety in Laboratory

Most activities that go on in the lab, like the experiments are dangerous in their own way and students should be taught the dangers inherent in such activities and how to avoid the hazards. The safety measures to be taken in the lab are in two categories:

1. Measures taken to prevent accident
2. Measures taken to care for injuries and damage caused by the accident.

Accidents in the lab could result from fire, cut from glass wares, heating substances and dangerous chemicals.

These are measures taken to ensure safety for all users of the lab facilities and lab properties. i.e when working in the lab the following habits should be followed:

1. Always wear protective glass, clothing at all times.
2. Always read the label on reagent bottle twice and carefully.
3. Always check glass-ware for cracks before use.
4. Glass storage bottle should be placed at or near floor level.
5. Point away from person test-tubes or any piece of equipment which may expel a gas or liquid.
6. When diluting acids, acids should be slowly added to water and not vice-versa.
7. Report all injuries however minor, breakage and faulty equipments.
8. Always flush drains whenever chemicals are poured in.
9. Always label container correctly with the full name and concentration of the content.
10. Know the position of the first aid box, fire extinguisher and other safety equipments and how to operate them.
11. Corrosive chemicals should only be brought in to the teaching laboratories when needed. They should never be stored above the shoulder height of the shortest person using the laboratory.
12. Eating, drinking and smoking in the laboratory are hazardous. Do not drink from laboratory taps.
13. Always wash your hand before leaving the laboratory and leave your lab coat behind.
14. All organic chemicals other than food stuffs should be treated as toxic. e.t.c.

2.10 Review of Empirical Studies

Alots of researches related to the presented study have been documented.

Archibong (1997), studied the based approach to lecture method on cognitive achievement of integrated science students in Edo State. A sample size of 98 students was used. Experimental group were subjected to activities and exercises on laboratory methods, while students in control groups were taught the discussion method. The result shows that students with activity Base approach achieved better.

In a related study, Alabi (1999), investigate between male and female performance in integrated science at Junior Secondary Schools Minna, Niger State. 127 students are the sample size used in the study. Multiple choice questions and answers was used for both pre and post-test. The final result favour male students.

Similarly, Femi (2007), in a study carried out to determined who performed better, between male and female students in physics at Federal College of Education, Zaria, Kaduna State. A sample of 87 students was used. An achievement test was administered. Male students performed far better than their female counterpart.

There is a strong deep seated, traditional and conservative belief among parents, teachers and students including the girls themselves, that the study of science, mathematic and Technology (SMT) subject is only for boys and men. They continue to consciously or unconsciously, believe that girls lack the ability and determination to study and succeed in these very difficult" subjects. Moreover, the girls believe that even if they succeed in SMT, there are few opportunities for them and they are not likely to attain their full potential in what they perceive to be male-dominated professions. (Wasagu, 2010).

In another development, Olufumilayo (2010) compared the effect of the Guided discovery and concept mapping teaching strategies on senior secondary school students performance in chemistry. A total 312 SS2 students was drawn from our schools in Bauchi Local government area of Bauchi state. A post test was administered on the two groups, to test how effective the two method used. Data were analyzed using t-test, the findings shows that both guided discovery and the concept map strategies are equally good, in terms of improving students performance in chemistry. However, students taught using mapping concept are likely to retain chemistry information better. Sani (2010) carried out investigation on the effects of laboratory practicals and traditional teaching method on the achievement of students in Senior Secondary school chemistry in Nasarawa State. 95 students constitute the sample size used for the study. Multiple choice questions and answers was use for pre/post-test. The investigator developed lecture note and practicals. The experimental group were taught both theory and practicals, while control groups were taught theory only. The outcome favours the experimental group.

In another related study, Effiong (2011) carried out a study on the effects of problem solving guide discovery and expository teaching strategies on students performance in redox reaction. A sample 112 SS2 students was used from four co-educational public secondary schools in Uyo of Akwa Ibom State. After investigations the result showed that those taught using problem solving and guided discovery method performed significantly better, than those taught with expository teaching method.

2.11 Summary and Uniqueness of the Study

Laboratory exercise is an approach to instruction which students learned how to interact, manipulate objects, recording and interprete data. Students are likely to remember concepts that they manipulate with their own hands. Practical work enhance the quality of learning, the old Chinese proverb says "what I hear, I forget, what I see, I remember and what I do, I understand" summarizes the effects of practical work in science learning; that atleast a practical demonstration is needed for meaningful learning which is personalized.

It is apparent that there can be no real progress in the training of students being scientific, both in thoughts and in behavior, so long as they are required to be just imitators, even if the syllabus includes the most recently revised concepts and classes meet in the most lavishly equipped laboratories. If we want science to be an education in the kind of creative and critical thinking we called scientific, then as Kerr (1963) suggested, we must make a conscious effort to provide practical experiences leading to this end. If practical work in school science is merely for verifying something already known or the performance of certain routine exercises, then it is doubtful whether its inclusion in science secondary schools is really worth the trouble and expense involved. It is only when the experiment is a planned part of the lesson, a finding-out process, encouraging reflective thinking that leads to the discovery of information or solving of problems that the child could experience what is thought to be distinctive educational merit of science practical work (Kamar, 1984).

The uniqueness of this research study is seen in areas like the geographical location, sample size, practical topics choosen by the researcher and survey work on level of laboratory utilization.

In most review literatures, the final outcome favour laboratory exercise or guided discovery techniques, which can be use in order to improved science teaching and learning.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the method and procedure that are used for conducting this study. It discusses the research design, study population, sample and sampling techniques, instrument for data collection, reliability and validity of the instruments, administration of the instruments and method of data analysis.

3.2 Research Design

Quasi experimental design and descriptive survey research were employed in this study. Quasi experimental design was employed because the researcher used intact classes (1 each) to group the six sample schools into two, the experimental and control group. He used two different lesson plans label appendix III as treatment to the groups. He taught the control group theory only, while the experimental group both theory and practical.

While on the other hand, the researcher used questionnaire to collect data for survey research. He survey thirty one schools including the six sample schools, details in appendix (vii). The questionnaire has three parts; part A is personal data, part B has five questions on laboratory utilization and part C were optional list choice with an item on factors that hinder the effective use of laboratory exercises in the state. Appendix I are three sets of practical questions, serving as practical guide. Appendix II are marking scheme for the practical guide, Appendix III are lesson plan for experimental and control group, while Appendix (iv) is the analyses for pilot study, for both the achievement test items and questionnaire for survey research of the 31 science schools across the state. Cronbach Alpha was used where YES choice is given the value of 2 and NO the value of 1.

3.3 Population of the Study.

The population covers all the senior science secondary school students in Kaduna State. There are 372 science schools, under the Ministry of Education in the State. Northern Educational zone has 143 schools, central zone 131 and southern zone 98. These schools have a population of 18,403 science students, in which Northern zone has 7,240, central zone 6,227 and southern zone 4,236 students. This information is summarized in Table 3.1.

Table 3.1: Kaduna State Educational Zones, Schools, Staff and Students Enrolment

Educational Zones	No. Of Science Schools	Students Population	Chemistry Teachers' Population
Northern educational zone	143	7,240	167
Central educational zone	131	6,227	127
Southern educational zone	98	4.936	101
Total	**372**	**18,403**	**395**

Source: Ministry of Education Kaduna State, 2014.

3.4 Sample and Sampling Techniques

The sample was drawn from the 372 science secondary school students in Kaduna State. Central education zone was selected by the researcher through stratified sampling technique, because all the students in the state covered the same scheme of work in chemistry. SS 2 students are the target population, because they have gone through their first year in chemistry and they have good information regarding chemistry laboratory exercises in their schools. They have covered about 70% of their course work, and they are not an examination class.

The researcher used six sample schools in the central educational zone through intact classes (1 each) to get its respondents. On the other hand, he used questionnaire to obtain data from the thirty one selected school on survey research. See Appendix (vii) for details

Table 3.2: Categorization of Sample Schools to Experimental or Control Group

S/no	**Name of school**	**Type**	**Intact classes**	**Group**
1	Govt. College Kaduna	`M	46	Experimental
2	Rimi College Kaduna	M	48	Control
3	Girls Sc. Sch. Kawo Kaduna	F	44	Experimental
4	Dalet Sch. Kawo Kaduna	F	52	Control
5	GSS Riga-Chikun Kaduna	Mixed	52	Experimental
6.	Govt. Sec. Sch Birnin Gwari Kaduna	Mixed	46	Control
	Total		**288**	

Source: Researcher’s field work, 2014

Table 3.4 shows the list of selected schools for the research, indicating if they are male or female, number in roll per each intact classes and the group they belong to (i.e experimental or control group). All the experimental schools intact classes were taught both theory and experimentation, while schools listed under control group intact classes were taught theory only, by the same researcher.

Table 3.3: Distribution of Study Sample by Gender

GROUP	M	F	TOTAL
Experimental	71	71	142
Control	71	75	146
Total	**142**	**146**	**288**

Source: Researcher’s field work, 2014

Table 3.3 shows the number of male and female students in the two groups (i.e experimental and control group).

3.5 Instruments for Data Collection

The following instruments were used for this study. They are; chemistry achievement test and questionnaire.

i) **Chemistry Achievement Test (CAT):** This consist of twenty items used for both the experimental and control group as pre-test and re-administered to the experimental group bas post-test, in order to observe the effects of the treatment. It is applicable to only the six sample schools. See Appendix (v) for details.

ii) **Questionnaire:** This instrument was used for survey research of thirty one selected science schools across the state. The questionnaire has three parts; part A is persona data, part B has five items to answer Yes or No, on laboratory utilization and part C is optional choice items on factors that hinder the effective use of laboratory exercises in the state. See Appendix (vi) for details.

3.6 Validity of Instruments

i) **Chemistry Achievement Test (CAT):** This was design by the researcher and was given to expert in Chemistry Department, Usmanu Danfodiyo University, Sokoto to determine the appropriateness of the items. Twenty four items were generated, after vetting 20 items were picked for this study. Because they have content validity with the topics choosen by the researcher.

ii) **Questionnaire:** The researcher also constructed a questionnaire and was given to some senior lecturers in the Department of Science and Vocational Education, Usmanu Danfodiyo University Sokoto. For validation and it was recommended for use.

3.7 Reliability of the Instruments

i. **Chemistry Achievement Test (CAT):** Reliability refers to the degree of consistency in which the instrument measures, what it is designed to measure over a long period of time. The test-retest method was use to determine its reliability. It was administered to SS2 students of Government Day Secondary School Kwoi, after an interval of two week, the same test was re-administered to the same set of students. The two set of scores were correlated using Pearson Product Moment Correlation Co-efficient (r) and the reliability co-efficient of 0.78 was obtained. Which shows that the instrument is reliable enough for this research work. See Appendix (iv) for details.

ii. **Questionnaire:** The test-retest method was use to determine its reliability. It was administered to SS2 students of Government Day Secondary school Kwoi, after an interval of two week, the same questionnaire was re-administered to the same set of students. The two set of scores were correlated using Cronbach Alpha, the reliability of 0.55 was obtained. Which shows that the instrument is reliable enough for used in this research work. See Appendix (iv) for details.

3.8 Administration of the Instrument

The researcher first sought for official permission from school administrators of the samples schools for the conduct of his research work. After receiving approval, he grouped the sample schools into two groups (i.e experimental and control group). The researcher taught both groups theory then administer them pre-test. He than taught the experimental group practical and administered them post-test, to determine the effect of such treatment. Detail in Appendix V.

The research questions without hypotheses (Laboratory utilization and factors that hinder the use of laboratory in the state) the researcher used questionnaire label appendix (vi) to get the response of his respondents. Part B of the questionnaire handle laboratory utilization and part C handle factors that hinder, the effective use of chemistry laboratory in the state science schools.

3.9 Method of Data Analysis

Two research questions without hypotheses, were analyzed using descriptive statistics. Cronbach Alpha was used to analyzed the data collected through survey research. Details are in Appendix (vii).

To test the stated null hypotheses, the researcher analyzed the data obtained using t-test, to find out whether the difference between the two mean scores are statistically significant or it occur by chance at α=0.05 level of significance. See details in Appendix (viii).

Ho_1 There is no significant difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not. The researcher used t-test for the analysis of this hypothesis.

Ho_2 There is no significant difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises. The researcher also used t-test for the analysis of this hypothesis.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents data analysis arising from data collected with 20 achievement test items for the six (6) sample schools and questionnaire used to survey 31 science school across the state on laboratory utilization and factors that hinder the effective use of laboratory.

4.2 Research Questions

The first research question which deals with the level of exposure to chemistry laboratory exercises among students under study was analyzed using frequency count arising from information gathered through the questionnaire label part B.

Table 4.1 has the summary work on survey research conducted from thirty one selected science schools across the state. To observe the level of exposure of secondary school students to chemistry laboratory. Northern and southern educational zones has ten schools each, while central zone has eleven including the six sample schools, obtained by random sampling techniques. The thirty one schools has ten respondents each, giving a total of three hundred and ten (310) respondents. The researcher went round these thirty one survey schools to observe their chemistry laboratory, before he administered the questionnaire for response from the respondents.

The summary of the whole exercise indicate that, there are poor conduct of laboratory exercises in science schools across the state. Details is seen in table 4.1, in which 58.1% indicate that practicals have not been conducted this term in chemistry. Then 41.9% conduct practicals in groups and 19.4% do not even have chemistry laboratory. This is a cleared indication that; there is a poor conduct of laboratory exercises in chemistry across Kaduna State science schools.

The second research question demand for factors that hinder the effective use of laboratory exercises in teaching chemistry to secondary school students in Kaduna State.

The researcher used the same questionnaire part C to gather the response of his respondents.

The three factors with high frequency count are;

(i) Teachers word load

(ii) Lack of adequate laboratory equipments and materials

(iii) Lack of teachers motivation (incentives). Table 4.1 part C has the details

Questionnaire part B observe the level of exposure to chemistry laboratory exercises among secondary school students in Kaduna state. i.e observing those that don't have as well as how these labs are utilize.

Table 4.1: Frequency count table on laboratory Utilization

S/No	**Questions**	**Response**			
		Yes	**No**	**Total**	**%**
1	Does the school have chemistry laboratory	250	60	310	19.4%
2.	Is your chemistry teacher using chemistry laboratory to teach theory?	50	260	310	16.1%
3.	Has practical been conducted this term?	130	180	310	58.1%
4.	Does each student handle laboratory equipment independently during practicals	-	310	310	100%
5.	Does students conduct practicals in group?	130	180	310	41.9%

Source: Researcher's Field work, 2014

Researcher in his finding observed that 19.4% of science schools in the state have no chemistry laboratory, 58.1% conduct no practical this term and 41.9% conduct practicals in group. It is now emperically established that there is low level of students exposure to chemistry laboratory exercises in the state.

Questionnaire part C

1. Tick three (3) factors that hinder the effective use of laboratory exercises to teach chemistry in your school.

Table 4.2: Factors that affect the effective use of laboratory exercises

S/No	Listed factors	Response		
		Freq Count	Total	%
1	Lack of teachers' motivation (incentives)	310	310	100%
2.	Lack of adequate laboratory equipments and materials	300	310	96.8%
3.	Teachers work load	230	310	74.2%
4.	Lack of laboratory attendant	150	310	48.4%
5.	It is time consuming	70	310	22.6%

Source: Researcher's Field work, 2014

In summary, student response in part C of the questionnaire indicate that time have the least number of respondents of all the factors mention. Because of students interest in laboratory work. There is also 100% support that incentives should be given to teachers, as a mean of motivating them for science practicals.

The third design question says, is there any difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not?

Table 4.2 reveals that there exists a statistical difference in the performance of students that are exposed to laboratory exercises with a mean of 17.20 (SD=1.93) performing between students that are not exposed to laboratory with a mean of 11.54 (SD=4.88). details is see in Appendix (viii).

The fourth research question says, is there any difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises?

Table 4.3 reveals that there exists statistical difference in the performance of male students exposed to laboratory exercises with a mean of 17.70 (SD = 1.74) performing better than their female counterparts that are also exposed to laboratory exercises with a mean of 16.68 (SD=1.96). Details is see in Appendix (viii).

4.3 Null Hypotheses Testing

HO_1 There is no significant difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not.

The test was analyzed and data were presented on Table 4.2

Table 4.3: T-test on performance of students in Kaduna state that are exposed to chemistry laboratory exercises and those that are not.

Variables	N	Mean	Std. Deviation	Df	t-cal	*t*-crit	Remark
Student exposed to laboratory exercises	142	17.20	1.932				
			4.881	286	22.36	*1.96*	H_0 rejected
Student not exposed to laboratory exercise	146	11.54					

Source: researcher’s field work, 2014

A look at Table 4.3 reveals that there exists difference in the performance of students exposed to laboratory exercises with a mean 17.20 (SD= 1.93) performing better than their counterparts that are not exposed to laboratory exercises with a mean of 11.54 (SD=4.88). The table also shows that the difference in the performance of the two groups of students resulted in a higher calculated t-value of 22.36 as against the t-Critical value of 1.96 at 286 degree of freedom. Thus, the hypothesis is rejected. This indicates that there is a significant difference in the performance of students exposed to chemistry laboratory exercises and those that are not exposed to chemistry laboratory exercises in secondary schools of Kaduna state. Details of calculations is see in appendix viii.

$H0_2$ There is no significant difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises.

The test was analysed and data was presented on Table 4.3

Table 4.4: T- test on performance of the male and female secondary schools students in Kaduna State, that are exposed to chemistry laboratory exercises.

Variables	N	Mean	Std. Deviation	Df	t-cal	*t*-crit	Remark
Male students exposed to laboratory exercises	142	17.20	1.932				
			4.881	286	22.36	*1.96*	H_0 rejected
Female students exposed to laboratory exercise	146	11.54					

Source: researcher's field work, 2014

A look at Table 4.4 reveals that there exists a statistical difference in the performance of male students exposed to chemistry laboratory exercises with a mean of 17.70 (SD= 1.74) performing better than their female counterparts that are also exposed to chemistry laboratory exercises with a mean of 16.68 (SD= 1.96). The table also shows that the difference in the performance of the two groups of students resulted in a higher calculated t-value of 13.71 as against the t-Critical value of 1.96 at 140 degree of freedom. Thus, the hypothesis is rejected. This indicates that there is significant difference in the performance of the students exposed to chemistry laboratory exercises to that of the female students that are also exposed to chemistry laboratory exercises in secondary schools of Kaduna state.

4.4 Summary of major Findings

1. Frequency count table on laboratory utilization indicate that 58.1% of science students in Kaduna State did not conduct chemistry practical this term. This is a clear indication that; there is low level of students exposure to chemistry laboratory exercises in the state.
2. Frequency count table on factors that affect the effective use of laboratory exercises indicate that time have the least number of respondents of all the factors mention. Because students have much interest in laboratory work. Out of many factors listed the three common with high frequency count are listed.
   (i) Lack of teachers motivation (incentives)
   (ii) Lack of adequate laboratory equipments and materials.
   (iii) Teachers work load.
3. There is a statistical significant difference in the performance of students that are exposed to chemistry laboratory exercises and those that are not (Exposed students mean 17.20 and those that are not exposed 11.54).
4. There is a statistical significant difference in the performance of male and female students that are both exposed to chemistry laboratory exercises (mean of male = 17.70 and mean of female = 16.68).

4.5 Discussion of Findings

The findings of all the four research questions stated earlier are discussed in this section

(i) What is the level of exposure of Secondary school students exposed to chemistry laboratory exercises?

(ii) A survey research conducted by the researcher round the thirty one sciences schools across the three educational zones in the state, revealed that, there is a poor conduct of laboratory exercises.

In science schools in the state. This implies that most science schools in the state do not conduct chemistry laboratory exercises with their students, or they conduct very few laboratory exercises below even students expectation. Hundred and eighty out of three hundred and ten respondents i.e (58.1%) indicate that no practical was done in chemistry this term.

Survey research still reveal that some chemistry teachers used laboratory periods for lecture. In the absent of equipments and materials teacher should improvise, to ensure students learned science by doing.

These could be considered as one of the many factors that lead to the fluctuating performance of students at senior secondary school certificate examination WAEC or NECO.

(iii) What factors hinder the effective use of laboratory exercises in the state. The three factors with higher frequency count obtained from the respondents are listed and discuss below.

(a) Teachers work load: Most of the science schools have one or two chemistry teachers, with not less than 150 students. These teachers will find it very difficult to teach and conduct regular laboratory exercises with their students. For that they keep hiding under the pretest of equipments and materials, so that they can teach the students only theory. Kaduna State Ministry of Education, recommends a teacher to 35students maximum (class size). If these ratio is used 150 students required four (4) chemistry teachers and not two(2), this implied that chemistry teachers in the state are over loaded.

(b) Lack of adequate laboratory equipments and materials: This is a popular reason teachers used. Because government are finding it difficult to fund science laboratories and teachers are not willing to improvise too, since laboratory exercise is an additional burden which attract nothing as an incentives. Teachers are not willing even if such materials and equipments are provided, due to lack of incentives attach. Therefore, government should boost teachers morals with science allowance as motivating factor.

(c) Lack of teachers motivation (incentives). Even if all the other factors are alter, teacher will not be willing to conduct laboratory exercises. But once incentives are given teachers, will be willing to conduct laboratory exercises with their students.

(iii). Is there any difference in the performance of secondary school students exposed to chemistry laboratory exercises and those that are not?

From Table 4.3: The result of the finding obtained shows that there exist a statistical significant difference in the performance of secondary school students in Kaduna State that are exposed to chemistry laboratory exercises and those that are not. This was tested by the researcher through the achievement test. The final outcome favoured students taught both theory and laboratory exercises over their counter part that were taught only theory.

This result is in agreement with Archibong (1997) and Sani (2010) in which the results favoured the experimental group. Reviewed work agreed with the present work, despite the gaping in years, difference in ample size, geographical local and the topics. The end result shows that laboratory exercises has direct effects on students performance.

(iv). Is there any difference in the performance of male and female secondary school students exposed to chemistry laboratory exercises.

From Table 4.4; the result obtained reveals that there exist a statistically significance different in the performance of male and female secondary school students that are exposed to chemistry laboratory exercises in Kaduna State. The researcher, tested the hypothesis by comparing the performance of male and female students in the experimental group. The result shows that male students exposed to laboratory exercises performed better than their female counterpart. This result also goes in line with Alabi (1999) and Femi (2007) findings, both of whom showed that male students performed better than female in science and chemistry subject in particular. Some research work reviewed indicate that male are better in science in their performance. This research work make no difference, despite the difference in years and locations that the researches are conducted.

In this regard, this research work is pointing out the need for laboratory exercises in chemistry, in order to enhance students performance in their Senior Secondary certificate Examination (SSCE) WAEC OR NECO.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gave a summary of the whole study, conclusion drawn from the study implication of the study, limitation of the study, recommendations and suggestions for further research were made.

5.2 Summary of the Study

Chapter one highlighted the background to the study, statement of the problem, objectives of the study, formulated research questions, Null hypotheses, significance of the study, as well as the scope and delimitation of the study. For the purpose of this study, four research questions were formulated and two null hypotheses are generate in conformity with the stated objectives.

The second chapter present a reviewed of related literature. Most of the reviewed literature encouraged the use of laboratory exercises in teaching chemistry Archibong (1997) and Sani (2010) in their findings, the result shows that students with activity Base approach achieved better. Which agree with the findings of this present study. Alabi (1999), Femi (2007), and Wasagu (2010), in their findings shows that male students performed better in science than their female counterpart. This also agree with the findings of this study in which male performed better when both were exposed to chemistry laboratory exercises.

The third chapter focused on the methodology of the study, which include; the research design, population of the study, sample and sampling technique, instruments for data collection, validity of the instruments, reliability of the instruments, administration of the instruments and methods of data analysis. The researcher used Quasi experimental design and descriptive survey research for this study. In quasi he used 6 sample schools and 31 science schools for survey research. He used stratified sampling technique for SS2 students of the central educational zone in Kaduna State. Questionnaire and achievement test was used to collect data.

Chapter four consist of data presentation and analysis, where the stated null hypotheses are tested using T-test statistical analyses and the results of such findings are interpret in summary form. The first null hypothesis was rejected, which implies that; there is a statistical significant difference in the performance of secondary school students in Kaduna state that are exposed to chemistry laboratory exercises and those that are not.

The second null hypothesis was also rejected, which revealed that male students performed better than female students, when both are exposed to chemistry laboratory exercises.

Survey research work revealed that there is a poor conduct of chemistry laboratory exercises in science school across the state. Many factors are responsible for it, but the major factor is lack of teachers motivation (incentives).

Finally, chapter five is the summary, conclusion, implication, limitation, recommendations and suggestion for further study.

5.3 Conclusion

The result of this research work shows that; there is a statistical significant difference in the performance of secondary school students in Kaduna State that are exposed to chemistry laboratory exercises and those that are not.

The research work also revealed that male students performed better than female students, when both are exposed to chemistry laboratory exercises.

Survey research work revealed that there is a poor conduct of laboratory exercises in science schools across the state, which could be one out of many reasons for students poor performance in external examination such as WAEC and NECO.

Similarly, survey research reveals that the major hindrance that affect the effective use of laboratory exercises in teaching chemistry in Kaduna State, is teachers motivation (i.e incentives).

5.4 Implications of the Study

1. This study has implication for science education at senior secondary school (SSS) level, since it is clear that proper utilization of laboratory exercises has positive relationship with students academic performance. This imply that students performance in chemistry in Kaduna State will keep on diminishing if laboratory exercises are not observed. This will affect the number of students that are willing to further their studies.

2. It would be very easy for chemistry teachers to explain some concepts in chemistry to their students in details and also students would find it easier to understand the

concept taught; because laboratory exercises have make the concept more familiar to both the teacher and the students.

3. The performance of male and female students in the control group of the sample schools would improved than what is observed, when they are instructed with laboratory exercises.

5.5 Limitations of the Study

This research study is limited in the following ways

(i) No Pre-test for homogeneity

(ii) Private schools were excluded in the stratified sampling techniques

5.6 Recommendations

(i) The researcher is recommending speed implementation by the State government, on the need for laboratory exercises, since it has positive relationship with students academic performance.

(ii) Chemistry teachers should see laboratory exercises as a need that cannot be avoided.

(iii) Kaduna state government should motivate science teachers with science allowance.

(iv)Kaduna state government should make sure that all the science schools in the state have science laboratory. They should provide these schools with adequate equipments and material for science practicals.

(v) Educational planner/administrators should always put into consideration provision for laboratory exercises for student to acquire scientific skills.

5.7 Suggestions for Further Study

(i) Similar work should be conducted by other researchers using different practical topics, sample size and different geographical location etc.

(ii) There is need to conduct a research work by comparing students performance between private and public schools that are exposed to chemistry laboratory exercises.

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APPENDICES

APPENDIX I

GUIDE TO CHEMISTRY PRACTICAL TEST

ITEM 1

CHEMISTRY PRACTICAL TEST FOR VOLUMENTARY ANALYSIS

1. Perform the following operation. Starting with two precautions to ensure accuracy.
   (a) Transfer 25cm^3 NaoH solutions, into a conical flask using pipette.
   (b) Fill a burette with a solution of Hcl, and titrate it against the above NaoH solution using methyl range as indicator.
   (c) Calculate the volume of acid required to neutralize the NaoH solution.
2. What is the appropriate indicator in acid-base titration.

ITEM II

CHEMISTRY PRACTICAL TEST FOR SEPARATION TECHNIQUE

3. Separate the mixture of water and kerosene, with the help of a separating funnel.

State two precaution taken to ensure accuracy in the separation.

ITEM III

CHEMISTRY PRACTICAL TEST FOR AMMONIUM ION

4. You are provided with an unknown salt. Carryout the following procedures, then from your observation identify the salt.

The procedure are;

(i) Dissolve an unknown salt in water
(ii) Heat the mixture for a while
(iii) Brings wet red litmus paper to the mouth of the test tube
(iv) Insert a glass rod in Hcl acid, then brings it to the mouth of the test tube.

APPENDIX II

MARKING SCHEME FOR GUIDE TO CHEMISTRY PRACTICAL TEST

ITEM I

MARKING SCHEME FOR VOLUMETRIC ANALYSIS PRACTICAL TEST

1a. precautions to ensure accuracy in transferring $25cm^3$ of an alkali (NaoH) into the conical flask.

(i) Ensure that pipette size is $25cm^3$and not $20cm^3$

(ii) Do not blow the last drop

(iii) Remove all air bubbles

(iv) Ensure that the lower meniscus falls on the mark.

(v) Put the pipette into an alkali (NaoH) solution, then draw it by sucking, until it just passes the mark. Use your dry finger tip as the stopper and by releasing the finger, pressure allow the solution to run out until the lower part of the meniscus falls on the mark. Then allow the solution to run out into a clean conical flasks. For the last drop allow the tip of the pipette to touch the side or base of the flask.

1b. Precautions to ensure accuracy in filling the burette with $HCl_{(aq)}$ solution.

(i) Clamp the cleaned burette firmly and vertically on the retort stand.

(ii) Close the tap of the burette

(iii) Insert the funnel than pour in the acid solution

(iv) Remove the funnel after filling the burette, above the zero mark.

(v) Ensure that the lower meniscus fall on the mark when all air bubbles are remove (initial burette reading.

Clamp firmly the burette vertically on the resort stand, close the taps than insert the funnel and pour in the acid solution, remove the funnel after filling it. Be sure that the lower meniscus is on zero mark of the burette, ensure all air bubbles are remove before taking your initial burette reading.

1c. Precautions to ensure accuracy in the volume of acid required to neutralized the alkali solution.

(i) Remove all air bubbles from the burette and pipette to obtain an accurate volume of the solutions.

(ii) Burette tap must be tight, to avoid leakage

(iii) Funnel should be remove before titration commences to avoid an increase in volume of the solution in the burette.

(iv) Avoid error in parallax, while taking burette reading

(v) Always use two or three drops of indicator to have a sharp end point.

(vi) Place the titration flask on the white surface to avoid over-shooting the end point.

In calculating the volume of acid required to neutralize the alkali solution. Subtract the initial burette reading from the final burette reading.

(2) Choice of indicator in acid base titration

i. Strong Acid Vs strong base - Any indicator (methyl orange or phenolphthalein)

ii. Strong Acid Vs weak base - Methyl orange

iii. Weak Acid Vs strong base - phenolphthalein

iv. Weak Acid Vs weak base - no suitable indicator

Indicator	**Colour in acid**	**Colour in neutral**	**Colour in base**
1. litmus paper	Red	Purple	Blue
2. Methyl orange	Pink	Orange	Yellow
3. Phenolphthalein	Colourless	Colourless	Pink

ITEM II

MARKING SCHEME FOR SEPARATING FUNNEL TECHNIQUE

(3i) Clamp the separating funnel empty, then close the tap.

(ii) Pour in the mixture through the short stem

(iii) Collect the denser solution first in a beaker.

(iv) Close the tap again as the dense liquid (water) approach its last drop.

(v) Between the last drops of water and first few drops of kerosene waste it or collect it separately.

(vii) Separating funnel therefore, contain kerosene, collect in a separate beaker.

ITEM III

MAKING SCHEME FOR QUALITATIVE ANALYSIS

(TEST FOR AMMONIUM ION)

TEST	**OBSERVATION**	**INFERENCE**
(4i) put an unknown salt in a clean test tube, then add few drops of NaoH solution	No precipitate nor any visible reaction.	Unknown salt.
(ii) Heat the mixture for a while	A colorless gas with a pungent an irritating smell is given off	SO_2, SO_3, NH_3 etc may be present.
(iii) Brings wet red litmus paper to the mouth of the test tube.	Red litmus paper turn blue	NH_3 gas may be present.
Insert a glass rod in HCL acid, then brings it to the mouth of the test tube.	White dense fume is formed.	NH_3 gas is confirmed.

APPENDIX III A

LESSON PLAN ON VOLUMETRIC ANALYSIS FOR EXPERIMENTAL GROUP

School:___________________

Class: SS 2 Science

Topic: Volumetric analysis

Date:

Time: 9:20-10:40am

Previous Knowledge: Student have learned about acid, base and salt, that can aid them to understand this topic volumetric analysis.

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

- Transfer 25cm^3 of an alkali (NaoH) into a conical flask, and state two precautions to ensure accuracy.
- Fill in HCl solution into a burette, and state two precautions to ensure accuracy in the filling.
- Calculate the volume of acid, require to neutralize the alkali solution (NaoH), State also two precaution to ensure accuracy.
- Choose appropriate indicator in acid-base titration.

Introduction: Teacher introduce his lesson, by asking the students what is neutralization reaction?

Presentation: Teacher present his lesson step by step.

Step 1: Teacher use the 25cm^3 size pipette to Transfer the 25cm^3 of NaoH into the conical flask and state the two precaution to ensure accuracy.

- Ensure that the pipette size is $25cm^3$ and not $20cm^3$
- Ensure that the lower meniscus falls on the mark.

Step 2: He fill in the burette with HCl acid to it zero mark, and state two precautions to ensure accuracy.

a) Clamp the cleaned burette firmly and vertically on the reford stand and close the tap.

b) Ensure that the lower meniscus falls on the zero mark when all air bubbles are remove (initial burrette reading).

Step 3: In calculating the volume of acid required to neutralize the alkali solution, teacher subtract the initial burette reading from the final burette reading for each titration. He also state two precautions needed to ensure accuracy.

c) Remove all air bubbles from the burrete and pipette to obtain an accurate volume of the solutions.

d) Funnel should be remove before titration commences to avoid on increase in volume of the solution in the burrette.

Step 4: Choice of indicator in acid base titration

i. Strong Acid Vs strong base – Any indicator (methyl orange or phenolphthalein)

ii. Strong Acid Vs weak base - Methyl orange

iii. Weak Acid Vs strong base – phenolphthalein

iv. Weak Acid Vs weak base – no suitable indicator

Indicator	**Colour in acid**	**Colour in neutral**	**Colour in base**
1. Litmus paper	Red	Purple	Blue
2. Methyl orange	Pink	Orange	Yellow
3. Phenolphthalein	Colourless	Colourless	Pink

Evaluation: Teacher use the following questions to evaluate his students level of understanding of the topic.

(i) Why is air bubbles removed?

(ii) Pippette last drop need not be blown, how do we obtain the last drop

(iii) Why is titration very important?

Conclusion: Teacher conclude his lesson by copying the summary note for them on the chalk board, after observing their good performance in the evaluation section.

APPENDIX III B

LESSON PLAN ON VOLUMETRIC ANALYSIS FOR CONTROL GROUP

School:________________

Class: SS 2 Science

Topic: Volumetric analysis

Date:

Time: 9:20-10:40am

Previous Knowledge: Student have learned about acid, base and salt, that can aid them to understand this topic volumetric analysis.

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

- Identify the use of pipette, and state two precaution to ensure accuracy in transfer $25cm^3$ **of NaoH solution.**
- Fill burrette with acid, state also two precaution to ensure accuracy in filling it.
- Calculate the volume of acid required to neutralized the base. State two precautions to ensure accuracy.
- Make choice of appropriate indicator in acid-base titration.

Introduction: Teacher introduce his lesson, by asking the students what is neutralization reaction?

Presentation: Teacher present his lesson step by step.

Step 1: pipette is use in the transfer of $25cm^3$ of NaoH solution and state two precautions to ensure accuracy.

- Ensure that the size is $25cm^3$ and not $20cm^3$
- Ensure that the lower meniscus falls on the mark.

Step 2: Burette is filled with acid solution, and he state the two precautions to ensure accuracy.

- Clamp the clean burrette firmly of vertically then close the tap.
- Ensure that the lower meniscus falls on the zero mark when all air buddles are remove (Initial burrette reading).

Step 3: In calculating the volume of acid required to neutralize the alkali solution, teacher subtract initial burrette reading from the final burrette reading for each titration. He also state the two precautions to ensure accuracy.

- Remove all air bubbles from the burrette and pipette to obtain accurate value of the solutions.
- Funnel should be remove before titration commences to avoid an increase in volume of the solution in the burrette.

Step 4: Choice of indicator in acid base titration

i. Strong Acid Vs strong base - Any indicator (methyl orange or phenolphthalein)
ii. Strong Acid Vs weak base - Methyl orange
iii. Weak Acid Vs strong base - phenolphthalein
iv. Weak Acid Vs weak base - no suitable indicator

Indicator	Colour in acid	Colour in neutral	Colour in base
4. Litmus paper	Red	Purple	Blue
5. Methyl orange	Pink	Orange	Yellow
6. Phenolphthalein	Colourless	Colourless	Pink

Evaluation: Teacher use the following questions to evaluate his students level of understanding of the topic.

(i) Why is air bubbles removed?

(ii) How do we obtain the last drop from the pipette?

(iii) Why is titration very important?

Conclusion: Teacher conclude his lesson by copying he summary note for them on the chalk board, after observing their good performance in the evaluation section.

APPENDIX III C

LESSON PLAN ON SEPARATING FUNNEL FOR EXPERIMENTAL GROUP

School:________________

Class: SS Science

Topic: Separating Funnel Technique

Date:

Time: 9:20-10:40am

Previous Knowledge: Student have learned about acid, base and salt, that can aid them to understand this topic volumetric analysis.

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

- Clamp an empty separating funnel and close the tap
- Pour in the mixture of kerosene and water through the short stem
- Use beaker to collect dense solution first (water) and close the tap
- Use the second beaker to collect last few drops of water and first drops of kerosene as a waste
- Use the third beaker to collect the kerosene left in the separating funnel.

Introduction: Teacher introduce his lesson, by explaining to the students how immiscible liquids can best be separated.

Presentation: Teacher present his lesson base on steps.

Step 1: teacher clamp an empty separating funnel with its tap closed.

Step 2: he pour in the mixture of kerosene with water through a short stem.

Step 3: He use the first beaker to collect water and close the tap when water is approaching his last drop.

Step 4: he use the second beaker to collect the last few drops of water and first few drops of kerosene together as a waste, then close the tap again.

Step 5: He use the third beaker collect kerosene less dense liquid

Evaluation: Teacher use these questions to test his students level of understanding of the topic.

i) Why is kerosene collected last?

ii) Between water and kerosene, which is denser?

Conclusion

Good performance of students in the evaluation section enables the teacher to copy summary note for them on the chalk board.

APPENDIX III D

LESSON PLAN ON SEPARATING FUNNEL FOR CONTROL GROUP

School:______________

Class: SS 2 Science

Topic: Separating funnel technique

Date:

Time: 9:20-10:40am

Previous Knowledge: Students have learned about evaporation technique which will help them to understand this topic.

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

- Know that water and kerosene are immiscible liquids
- The mixture of water and kerosene can best be separated by a separating funnel.

Introduction: Teacher introduce his lesson, by explaining to the students what are immiscible liquids.

Presentation: Teacher present his lesson base on steps.

Step 1: Teacher explains and give example of an immiscible liquids.

Step 2: He explain to the students, that a mixture of water and kerosene can best be separated by a separating funnel.

Evaluation: Teacher used these questions to test his student's level of understanding of the topic.

i) Why is kerosene collected last?

ii) Between water and kerosene, which is denser

Conclusion

Good performance of students in the evaluations section enables the teacher to copy summary note for them on the chalk board.

APPENDIX III E

LESSON PLAN ON QUALITATIVE ANALYSIS FOR EXPERIMENTAL GROUP

School:______________

Class: SS Science

Topic: Separating Funnel Technique

Date:

Time: 9:20-10:40am

Previous Knowledge: Students have learned about nitrogen cycle, this will be a good guide to this topic-test for ammonium ion.

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

- Use spatula to put an unknown salt in a test-tube, then add few drops of NaOH solution then record your observation.
- Heat the mixture for a while, then record their observation.
- Bring a wet red litmus paper to the mouth of the test-tube then record your observation
- Dip a glass rod in HCl acid, then bring it to the mouth of the test tube, were the gas is involve, record your observation and inference.

Introduction

Teacher introduce the topic by explain what is hydride.

Presentation

Teacher present his lesson by step.

Step 1: Teacher use spatula to put a sample of an unknown salt in a tubes, then add few drops of NaOH solution.

Step 2: He heat the mixture for a while and teach the students how to record their observation and inference.

Step 3: He bring wet red litmus paper to the mouth of the test-tube then show the students what happen before record his observation.

Step 4: He dip in glass rod in HCl acid abd bring it to the mouth of the test-tube, then record his observation and inference.

Evaluation: Teacher use these questions to test his students level of understanding of the topic.

i) What is hydride?

ii) Which of the step confirmed the presence of ammonia gas

Conclusion

Students good performance in the evaluation section enable the teacher to copy a summary note for them on the board.

APPENDIX III F

LESSON PLAN ON QUALITATIVE ANALYSIS FOR CONTROL GROUP

School_______________

Class: SS 2 Science

Topic: Qualitative analysis (test for ammonium ion)

Date:

Time: 9:20-10:40am

Previous Knowledge: Students knowledge on nitrogen cycle, will be a good guide to this topic "test for ammonium ion".

Behavioural objectives: At the end of the lessons students should be able to;

- Record their observation, when NaOH solution is added to an unknown salt in a tets-tube.
- Observed and record what happen when the mixture is heated for a while
- Record what happen when wet red litmus is brought to the mouth of the test-tube where the gas is involves.
- Record the observation, when a glass rod dip in HCl acid and then brought it to the mouth of the test-tube.

Introduction

Teacher explain that ammonia is a hydride of nitrogen.

Presentation

Teacher present his lesson, step by step.

Step 1: Some few drops of NaOH solution were added to an unknown salt in a test tube, then record observation was made by teacher.

Step 2: The mixture was then heated for a while, students are ask to observed what happen.

Step 3: Wet red litmus was brought to the mouth of the test-tube to see what happen to the red litmus.

Step 4: A glass rod was dip in HCl acid, and brought to the mouth of the test tube he then record his observation and inference.

Evaluation

Teacher use these questions to test students level of understanding of the topic.

i) What is hydride?

ii) Which of the step confirmed the presence of ammonia?

Conclusion

Students good performance in the evaluation section enable the teacher to copy a summary note for them on the board.

APPENDIX IVA

PILOT STUDY ON ACHIEVEMENT TEST
GOVERNMENT DAY SECONDARY SCHOOL KWOI (SSII)

	TEST SCORE	**RE-TEST SCORE**			
S/N0	**X**	**Y**	**XY**	**X^2**	**Y^2**
1	10	18	180	100	324
2	10	18	180	100	324
3	13	20	260	169	400
4	8	16	128	64	256
5	7	15	105	49	225
6	5	16	80	25	256
7	8	17	136	64	289
8	11	20	220	121	400
9	10	17	170	100	289
10	5	17	85	25	289
11	8	17	136	64	289
12	7	15	105	49	225
13	10	14	140	100	196
14	8	17	136	64	289
15	6	15	90	36	225
16	5	11	55	25	121
17	5	15	75	25	225
18	6	15	90	36	225
19	2	10	20	4	100
20	6	13	78	36	169
	150	**316**	**2469**	**1256**	**5116**

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

$$r = \frac{2469 - \frac{(150)(316)}{20}}{\sqrt{\left(1256 - \frac{(150)^2}{20}\right)\left(5116 - \frac{(316)^2}{20}\right)}}$$

$$r = \frac{2469 - \frac{47400}{20}}{\sqrt{\left(1256 - \frac{(22500)}{20}\right)\left(5116 - \frac{99856}{20}\right)}}$$

$$r = \frac{2469 - 2370}{\sqrt{(1256 - 1125)(5116 - 4992.8)}}$$

$$r = \frac{99}{\sqrt{(131)(123.2)}}$$

$$r = \frac{99}{\sqrt{16139.2}}$$

$$r = \frac{99}{127.04}$$

$r = 0.7793$

$\therefore\ r = \underline{0.78}$

APPENDIX IVB
PILOT STUDY ON QUESTIONNAIRE
GOVERNMENT DAY SECONDARY SCHOOL KWOI (SSII)
(Using Cronbach Alpha Technique for Analysis)

Instruction YES is giving a value of 2 and N0 the value of 1

TEST SCORE

S/NO	1	2	3	4	5	TOTAL
1	1	2	2	1	2	8
2	2	1	1	1	2	7
3	1	1	1	2	2	7
4	1	1	1	1	1	5
5	1	2	1	1	1	6
6	1	1	1	2	1	6
7	1	1	1	1	1	5
8	2	2	1	1	1	7
9	2	1	2	1	1	7
10	1	2	2	1	1	7
11	2	2	2	1	1	8
12	1	1	1	1	2	6
13	2	1	1	1	2	7
14	1	2	1	2	1	7
15	1	1	1	1	1	5
16	2	2	1	1	2	8
17	1	1	1	2	1	6
18	1	2	2	1	1	7
19	1	1	1	1	1	5
20	1	1	1	1	1	5
21	2	1	1	1	2	7
22	2	2	1	1	2	8
23	1	1	1	2	1	6
24	1	1	1	1	1	5

25	2	2	2	1	2	9
26	1	2	2	1	2	8
27	1	1	1	1	1	5
28	1	2	1	2	1	7
29	2	2	1	2	2	9
30	2	1	1	1	1	6
31	1	2	1	2	1	7
32	1	2	2	1	1	7
33	1	1	1	1	1	5
34	1	2	1	1	2	7
35	1	2	1	2	1	7
36	2	1	1	2	2	8
37	2	2	1	1	1	7
38	2	1	2	1	1	6
39	1	1	2	1	1	6
40	1	1	1	1	1	5
41	1	1	1	1	1	5
42	2	2	1	2	2	9
43	1	1	1	2	1	6
44	2	1	1	1	1	6
45	2	1	2	1	1	7
46	1	1	1	1	2	6
47	1	1	1	2	2	8
48	2	2	1	1	2	8
49	1	1	1	1	1	5
50	2	1	1	1	1	6
						330

RE-TEST SCORE

S/N0	1	2	3	4	5	TOTAL
1	1	1	2	2	1	7
2	2	1	1	2	2	8
3	1	1	1	2	1	6
4	2	2	2	1	2	9
5	2	2	1	2	1	8
6	1	1	1	1	1	5
7	2	2	2	2	2	10
8	1	1	2	1	2	7
9	2	2	2	1	2	9
10	1	1	1	2	1	6
11	1	1	1	1	1	5
12	2	2	1	2	2	9
13	2	1	1	1	2	7
14	1	2	2	1	1	7
15	2	2	1	2	1	8
16	2	1	2	1	2	8
17	2	2	2	2	2	10
18	1	1	2	1	1	6
19	1	2	2	2	1	8
20	2	2	1	1	1	7
21	1	1	1	1	1	5
22	1	2	1	2	1	7
23	1	1	2	1	1	6
24	2	2	2	1	1	8
25	2	1	2	2	2	9
26	1	1	1	1	2	6
27	1	2	2	2	1	8
28	2	2	2	2	1	9

29	1	1	1	2	1	6
30	1	1	2	2	2	8
31	1	1	2	2	1	7
32	2	1	1	1	2	7
33	1	2	2	2	2	9
34	1	1	1	2	1	6
35	1	2	2	1	2	8
36	2	2	1	2	1	8
37	1	2	2	1	1	7
38	1	1	1	1	1	5
39	1	1	1	1	1	5
40	1	2	1	2	1	7
41	2	2	1	2	1	8
42	1	2	1	1	2	7
43	1	1	1	1	2	6
44	1	1	1	1	2	6
45	2	2	2	2	2	10
46	1	1	2	2	1	7
47	1	2	1	2	1	7
48	1	1	1	2	1	6
49	1	2	2	2	1	8
50	2	2	1	1	1	7
						365

```
GET DATA /TYPE=XLSX
  /FILE='C:\Users\sheiktsagem\Documents\OTHER PEOPLE WORKS\Bonah I.
Yero Data.xlsx'
  /SHEET=name 'Sheet1'
  /CELLRANGE=full
  /READNAMES=on
  /ASSUMEDSTRWIDTH=32767.
  RELIABILITY
  /VARIABLES = T1 T2 T3 T4 T5 R1 R2 R3 R4 R5
 /SCALE ('ALL VARIABLES')ALL
/MODEL=ALPHA.
```

Reliability

[Dataset1]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded[a]	0	.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	No. of Items
.547	50

APPENDIX VA

CHEMISTRY ACHIEVEMENT TEST

(20 MARKS)

INSTRUCTION: ANSWER ALL THE QUESTIONS, ALL QUESTIONS CARRY EQUAL MARKS.

TIME ALLOWED: 30 MINUTES

1. The capacity of burrette is________

   a) $20cm^3$ b) $10cm^3$ c) $50cm^3$ d) $25cm^3$

2. One of the following is an alkaline gas

   a) $HCl_{(g)}$ b) $NH_{3(g)}$ c) $N_{2(g)}$ d) $SO_{2(g)}$

3. The solute collected by the filter paper during filtration techniques is known as

   a) Filtrate   b) Solvent   c) Residue   d) Solid

4. A suitable indicator for strong acid and a weak base is;

   a) Methyl orange   b) Any indicator   c) Phenolphthalein

   d) No suitable indicator

5. ________________ Is clamp on the retort stand during filtration

   a) Burrette   b) Conical flask   c) Pippette   d) Beaker

6. Immiscible liquids are best separated by_______ technique

   a) Evaporation   b) Decantation   c) Chromatography

   d) Separating funnel

7. In the mixture of water and kerosene, kerosene is collected last because; it is

   a) Denser than water   b) Equal in density   c) Lighter than water

   d) A gas

8. Remove funnel from the burrette before filtration commences this is to avoid

a) Increase in volume b) Decrease in volume c) Leakage

d) Error of parallax

9. Acid have a _________ taste

a) Bitter b) Sour c) Neutral d) Sweet

10. Always use two or three drops (maximum) of indicator during titration so as to obtain

a) Fast result b) Sharp end point c) Homogeneous solution

d) Leakage.

11. The substance used to detect the end-point of a titration is called_______

a) Temperature b) paper c) Thermometer d) Indicator

12. Titration enables one compare which of the following of the reacting solution?

13. Solute is transfer into a test-tube by the help of:

a) Petric dish b) Beaker c) Spatula d) Conical flask

14. When a glass rod dip in HCl acid is brought to the mouth of a test-tube where a gas is involve, a white dense fume is formed this is a confirmed test for

a) Ammonia gas b) Chlorine gas c) Nitrogen gas d) Hydrogen chloride gas.

15. Titration flask is place on white surface, this is to avoid_____

a) Error of parallax b) Over shooting the end point

c) Increase in volume d) Leakage

16. These salts are soluble in water **except**

a) Sodium b) Ammonium c) Potassium d) Sulphate

17. A suitable indicator used for weak acid and a strong base is;

a) Methyl orange b) Industrial dye c) Phenolphthalein

d) Litmus paper

18. Reaction between acid and base to form salt and water only is term______

a) Saponification b) Neutralization c) Esterification d) Evaporation

19. The colour of phenolphthalein on acid is;

a) Yellow b) Pink c) Purple d) Colourless.

20. Base are transfer into a conical flask by the help of;

a) Pippette b) Burrette c) Beaker d)Test-tube.

APPENDIX VB

MARKING SCHEME FOR ACHIEVEMENT TEST

(EACH QUESTIONS CARRY 1 MARK)

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

APPENDIX (VI)

QUESTIONNIARE

Instruction: Read the instruction carefully. Answer all questions. You are requested to read each statement attentively and sincerely provide the require information. The information provided will be strictly used only for this study.

Part A is personal Data, in part B, Yes or No is provided beside each statement, part C is multiple choice questions. You are to indicate the key response by ticking the option(s) that is most appropriate for it.

PART A: personal data

Name of school ----------------------

Sex------------------------------------

Class-----------------------------------

PART B. Survey research questionnaire on utilization of chemistry laboratory exercises in Kaduna State science secondary schools.

S/N0	QUESTION	YES	N0
1	Does the school have chemistry laboratory?		
2	Is your chemistry teacher using chemistry laboratory to teach theory?		
3	Has practical been conducted this term?		
4	Do each student handle laboratory equipments independently during practical?		
5	Does students conduct practical in group?		

PART C

Questionnaire on factors that affects the effective use of laboratory exercises.

1. Choose the first three factors that could hinder the effective use of chemistry laboratory exercises in teaching chemistry in your school.

(i) Teachers work load.

(ii) Lack of adequate laboratory equipments and materials

(iii) Lack of teachers motivation (incentives)

(iv) Lack of laboratory attendant.

(v) It is time consuming

APPENDIX (VII)

List of selected schools for survey research, on laboratory utilization

S/N0	Names of schools	Educational zone	Gender
1	Science Sec. Sch Kufena	Northern	M
2	Science Sec. Sch ikara	Northern	M
3	Science Sec. Sch Makarfi	Northern	M
4	Girls Sci.Sec.Sch. Samaru Zaria	Northern	F
5	Girls sci.sec.sch. Soba	Northern	F
6	Govt sec.sch.Giwa	Northern	Mixed
7	Govt sec.sch.Tukur-Tukur	Northern	Mixed
8	Govt sec.sch.Lere	Northern	Mixed
9	Govt sec.sch.Yar-Kasuwa	Northern	Mixed
10	Govt sec.sch.pambeguwa	Northern	Mixed
11	Govt sec.sch.T/wada	Central	Mixed
12	Govt sec.sch U/Rimi	Central	Mixed
13	Govt.sec.sch U/Dosa	Central	Mixed
14	Govt sec.sch Mando	Central	Mixed
15	Govt sec.sch.Rigasa	Central	Mixed
16	Govt College Kagoro	Southern	M
17	Govt Sci.Sch.Fadan-Kaje	Southern	M
18	Girls Sci.Sch. Kwoi	Southern	F
19	Girls Sci. sch. Zokwa	Southern	F
20	Girls sci.sch.Iddah	Southern	F

21	Girls sci.Sch.Kagarko	Southern	Mixed
23	Girls sci.sch.Sabo Tasha	Southern	Mixed
24	Girl sci.sch.Kakuri	Southern	Mixed
25	Queen Amina College Kaduna	Southern	F
26	Govt. College Kaduna	Central	M
27	Rimi College Kaduna	Central	F
28	Girls Sc. Sch. Kawo Kaduna	Central	F
29	Delet Sch. Kawo Kaduna	Central	F
30	GSS Riga-Chikun Kaduna	Central	Mixed
31	Govt Sec. Sch Birnin Gwari Kaduna	Central	Mixed

Source: Researcher's field work, 2014

APPENDIX (VIII)

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T-Test

Notes

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	Split File	<none>
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	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=EXP M WITH CNT F (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.08

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[DataSet1]
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Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	EXP	17.20	142	1.932	.162
	CNT	11.54	142	4.881	.410
Pair 2	M	17.70	71	1.735	.206
	F	16.68	71	2.006	.238

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	EXP & CNT	142	.978	.000
Pair 2	M & F	71	.953	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	EXP - CNT	5.662	3.017	.253	5.161	6.163	22.360	141	.000
Pair 2	M - F	1.028	.632	.075	.879	1.178	13.712	70	.000