

**EFFECT OF SIMULATION MODEL ON ATTITUDE, RETENTION AND
PERFORMANCE IN QUALITATIVE ANALYSIS AMONG SECONDARY
SCHOOL CHEMISTRY STUDENTS, ZARIA – NIGERIA**

BY

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FACULTY OF EDUCATION
AHMADU BELLO UNIVERSITY,
ZARIA –NIGERIA**

APRIL, 2018

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APRIL, 2018

DECLARATION

I hereby declare that this thesis titled “Effects of Simulation Model on Attitude Retention and Performances in Qualitative Analysis among Secondary School Chemistry Students, Zaria- Nigeria” has been written by me. It is a record of my own research work and has not been presented in any previous application for a higher degree. All quotation and sources of information are specifically acknowledged by means of references.

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CERTIFICATION

This thesis entitled “Effect of Simulation model on Attitude, Retention and Performances in Qualitative Analysis among Senior Secondary School chemistry Students, Zaria-Nigeria” by Abdulmumin MAGAJI with Reg. No. P15EDSC8066 meets the requirement governing the award of Master Degree (M. Ed.) Science Education of Ahmadu Bello University Zaria and is approved for its contribution to knowledge and literary presentation.

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Date

DEDICATION

This work is dedicated to my late mother Safiya Umar, my late wife Karimatu Muhammad Sani, my brother Yasir Muhammad Sani, my present wife Khadija Muhammad Sani for their inspirations and encouragement.

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ABBREVIATIONS

F.M.E	-	Federal Ministry of Education
F.R.N.	-	Federal Republic of Nigeria
NCE	-	Nigerian Certificate in Education
NECO	-	National Examination Council
NERDC	-	Nigerian Research Development Council
QAPT	-	Qualitative Analysis Test
QASP	-	Qualitative Analysis Simulation Package
SAQA	-	Students Attitude on Qualitative Analysis
SAQACQ	-	Student Attitude Toward Qualitative Analysis Concept Questionnaire
SSCE	-	Senior Secondary School Certificate
WAEC	-	West African Examination Council

OPERATIONAL DEFINATION OF TERMS

- Academics performance: Is the degree of success attained by an individual or body in line with their academic pursuit that is measured by amongst other things, examination.
- Simulation: Is imitating some aspects of the world similar to the way it could react in a real life situation.
- Retention: Ability of students in experimental and control groups to recall material learned after treatment and post test
- Model: Is a human construct that help a better understanding of real world system.
- Qualitative analysis: is the identification of cations and anions in giving solution of Chemical substances.
- Lecture method: A teaching strategy where teacher dominate the class and student remain passive.
- Attitude: Is the disposition or state of mind.

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ABSTRACT

This study examined the effects of simulation model on students' academic Performance, attitude and retention in qualitative analysis among Senior Secondary School students in Kaduna state. The motive behind the study is connected to persistent failure of students in SSCE due to poor attitude generating low retention among learners. In line with this, four research questions and hypotheses were developed. The study adopted pretest posttest Quasi-experimental control group design. The population of the study comprised of eight (8) governments-owned, coeducational Senior Secondary Schools in Zaria Inspectorate Zone with a total number of 645 SSS II Chemistry students. Two Senior Secondary Schools were systematically selected for the study. In the school selected, intact SS II classes were used from forming a sample size of 102 Students. Two validated instruments, Qualitative Analysis Performance Test (QAPT) and Students Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ) were developed by the researcher and used for data collection. The reliability coefficient of the QAPT and SAQAQ were 0.66 and 0.96 respectively. Research questions were answered using mean and standard deviation, while null hypothesis were tested at $p \leq 0.05$ level of significance using t-test and Kruskalwalis test. Statistics and the research findings show that there was significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation. I concluded that the effect of simulation method on students' academic performances and attitude in qualitative analysis concepts as measured by QAPT and SAQAQ where statistically significant towards improving teaching and learning. This study recommended that the Federal and state ministry of education should provide relevant materials in secondary schools for developing and implementing simulation teaching to enhance attitude and performance of students. Similarly, Secondary school teachers should be trained by the teacher training institutions on developing and utilization of simulation methods in teaching.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Chemistry is viewed by Lado (2010) as systematic discipline or molecular and experimental science. Ezeliion (2009) posited that chemistry is very critical to the understanding of natural world and the ability to understand some basic issues facing a society. It is also the study of matter and its properties, the change they undergo and the energy factors associated with these changes (Ababio 2002). Chemistry occupies pivotal positions in science and technology and is needed by everybody and in every aspect of human life (Abubakar&Ejimaji 2010). The researcher referred to Chemistry as a science subject that deals with organized activities to be carried out either in a class or a laboratory.

Chemistry is a compulsory subject of science for senior secondary education, hence Abubakar and Alao (2010) reported the need for qualitative and functional chemistry education, which can be achieved through students cognitive level development in chemistry concepts like qualitative analysis. This is why the National Policy on Education (F.M.E, 2007), emphasizes the teaching of science process skills in schools. The significance attached to chemistry subject, as stated by the Federal Republic of Nigeria (FRN, 2013) resulted in making it compulsory for candidates at Senior Secondary School Certificate (SSCE) and National Examination Council (NECO) examinations at the end of their SS III training to seat for the subject.

The general aims of practical activities in teaching and learning of science include but not limited to enabling the learners to visualize and understand scientific concept; develop process skills; develop effective skills and generate enthusiasm and gratification in the subject matter. This is why National Policy on Education (FRN, 2007) emphasizes

the teaching and learning processes and principle. Therefore, the policy recommends practical, exploratory and experimental methods; Utulu (1998) observed that one of the purposes of the National Policy on Education is to give students opportunity of acquiring practical skills required for self-reliance and employment so as to minimize the present unemployment hazard. The concept of Qualitative analysis is a component of practical chemistry in Nigeria's chemistry Curriculum whose objective includes training students to develop skills in observing and interpreting the salt under analysis (FRN, 2013).

Simulation is an instructional technique that teaches some aspect of the world by imitating or replicating it. Students are not only motivated by simulation, but can learn interacting with them in a manner similar to the way they could react in real situations. In almost every instance a simulation also simplifies reality by omitting or changing details. In this simplified world, the student solves problems, learn procedures comes to understand the characteristic of phenomena and how to control them or learn what actions are to be taken in different situations (Alessi & Trollip, 1991). Ingalls (2008) reported that simulation is a powerful tool if understood and used properly. Ingalls further referred to simulation as an instructional tool for eliminating undesirable component of real situation in order to reach predetermined learning outcomes. Isa, (2012), posited simplification allows learners to focus on critical information or skill and make learning easier. This perspective for the use of simulations is very appropriate for accomplishing simplified behavioral and cognitive tasks.

Humphreys and Imberted (2012), Stated that is a unique modeling and simplification of some structure of systems. While Simulation model is described as learning tool used in our educational system, simulation model is a representation of a system. This could be a picture, diagram, symbol, signs, and equations and so on (Anu, 1997).

The purpose of a model is to enable the analysis to predict the effect of change to qualitative analysis concept of chemistry and to reduce the chance of student's failure in qualitative analysis for examination. Another purpose of an educational simulation is to motivate the learners to engage in problem solving, hypothesis testing, experiential learning, schema construction and development of mental models (Winn & Snyle, 1996), Duffy and Cunningham (1996). To facilitate leaning educational simulation, rely heavily on scaffolding (Duffy & Cunningham, 1996), Coaching and feedback (Aless&Trollip 2001).

Academic Performance is a method of determining whether a successful completion has taken place for each students. Okafor (2000) on the other hand maintain that academic Performance concerns mental health care. It is based on the degree intellectual simulation that the child could receive from learning situation. NERDC(2007) and Olurundare, (2010), revealed that the academic Performance of students in chemistry was poor at SSS level. Annual report of both the West African Examination Council (WAEC) (2007-2010) and National Examination Council (NECO) revealed that the poor academic Performance of students in chemistry still persist. Similar report from WAEC, indicated that the result of 2010 November/December West African Senior School Certificate Examination were not encouraging as only 20.04% percent of 310,077 candidates obtained five credits in core science subject. Thus there is a need to adopt alternative strategy for improving students' performance such as the use of simulation model.

Gender of students creates a lot of concern among researchers world over (Bichi, 2002). Many studies such as Usman (2010) revealed that difference exist in the performance of students in integrated science due to exposure to indoor and outdoor strategies in favour of male students. The case is different when compared with the work

of Mari (2008), Atadoga and Lakpini (2013) who found gender disparity in favour of female students. However, Obeka (2015) revealed no gender disparity among students when exposed to innovative teaching strategy with models in environmental concept of geography. Similarly, Bello (2015) revealed that when students were exposed to Computer-Aided instruction, performance of male and female will not differ significantly and hence is gender friendly. Therefore this study used simulation models to see what the result will be.

Attitude in this study is an aspect of affective domain concerned with beliefs, interest, motives, need, satisfaction, feeling, and believe. It is predisposition which makes an individual to behave or react in a particular way. The effective disposition of the students has direct relevance in his ability to learn, in his attitude toward the value of education (Osuafor, 2001). For students to develop positive attitude toward a subject there is need to get them interested in the learning task. Dageinty and Coll (2009) opined that a satisfactory grade in a class does not necessarily imply a positive attitude toward the subject; however, both positive and negative attitude will influence students' performance. Majority of teachers in our school assess the performance of students based on cognitive aspect neglecting both affective and psychomotor aspects of students. Therefore, in simulation the interaction and activity involved will enhances attitude of students in a learned concept.

Retention is the ability to remember tasks, or material learnt concepts. It is also defined by Bichi (2002) as the ability to retain and recall information or knowledge gained after learning. Obeka (2010) investigated quite a lot of variables that affect retention such as tasks to be performed, learner's previous experiences, the interval between lesson and evaluation as well as instructional strategy used by teachers. Report revealed that students' ability to remember or recall previous learning task during SSCE examination is

a contributory factor to their failure. However scholars revealed the role of inappropriate methodology of teaching chemistry such as lecture method as the contributory factor of mass failure among students. Other factor observed is inability of teachers to take into account the affective domain of students. Therefore, in simulation the interaction and activity involved will enhances retention of students in a learned concept. It is against this background that this study is set and examined the effect of simulation model on secondary school students' Performance, retention and attitude in qualitative analysis concepts at Secondary Schools.

1.1.1 Theoretical Framework

This study is based on the established constructivist theories of learning stems from the work done by several theories including Robert Gagne information processing theory, Gestal theory, Brunner learning theory, (Dewer, 2005) Papert (2007). Laurilerd (2000) pointed that constructivist theory has it root in cognitive psychology, philosophy, learning theory and education theory, and that the constructivist theory of teaching and learning directly relates to the mission of the centre of teaching excellence in which students and faculty alike are seen as partners in learning and in applying learning in a spirit of inquiry and zest for problem solving. The constructivist approach to teaching focuses on active participation of student in teaching process (Duggins, 2002). Gagne (2008) have shown that the basic ideas behind constructivism focuses on the student taking an active role in their own learning as they construct their own knowledge by integrating the new information with pre-existing somatic constructs. Key to this style of teaching and learning is the notion that the learning activity must be relevant and engaging to the students (Duggin, 2002). This approach centre on problem solving and critical thinking skills that the student utilizes by applying approaches based on their prior

knowledge and experience to a new problem situation and integrating those approaches with new experience and knowledge to construct a new level of understanding.

Isa, (2012) stated that in the constructivist theory, the teacher is typically viewed as facilitator or coach in the constructivist learning approach. Seymoun, (2008) further asserted that the role of the teacher is to guide the student through the learning process by stimulating the student's critical thinking, skills and providing learning situation, environment, skill content and task that are relevant and realistic and simulate real-world context. The emphasis therefore is on the need to have students actively involved in applying the knowledge in a problem-solving situation. Therefore teachers must present information in the way that encourages student to seek their own answers using strategies offered by activity-based instructional strategy such as discovery method, inquiry and problem solving among others. This study adopted constructivism as a theoretical framework to examine the effect of simulation model on secondary school students' Performance, retention and attitude in qualitative analysis concepts at Secondary Schools.

1.2 Statement of the Problem

Qualitative analysis is an aspect of senior secondary chemistry practical in which students are examined at SSCE by the West African Examination Council (WAEC) and National Examination Council (NECO). Science teaching in Nigerian- Secondary School has several challenges according to Okebukola (1996). Olurundare, (2010), revealed that the academic Performance of students in chemistry is generally poor at SSS level. Annual report of both the West African Examination Council (WAEC) (2007-2010) and National Examination Council (NECO) revealed that the poor academic Performance of students in chemistry still persists. Report from WAEC, indicated that the result of 2010

November/December West African Senior School Certificate Examination were not encouraging as only 20.04% percent of 310,077 candidates obtained five credits in core science subject. In a related development Sam, (2011) conducted a research on academic Performance of science students in Nigeria secondary schools. Examination of past academic Performance in secondary schools indicated that in 2007, only 25.54% percent obtained five credits in core science subjects. There was a slight improvement in 2009 when 25.75% percent pass the examination, figure that went down in 2010 to 20.04% percent (Olurundare, 2010). To clearly understand the rate of failure among students, statistical analysis were presented in Table 1.1:

Table 1.1: Failure rate among Students in WAEC between 2007- 2016 in Kaduna State

Year	No. of candidates	No of student pass	Percentage (%) pass	No of student fail	Percentage (%) Failure
2007	301,740	37	63.8	21	36.26
2008	262,842	19	12.8	39	34.40
2009	250,323	47	42.7	63	49.44
2010	357,658	65	47.4	72	37.86
2011	389,462	128	55.4	163	50.94
2012	251,000	105	41.08	141	56.00
2013	190,000	175	92.11	9	4.7
2014	103,000	86	83.4	12	11.6
2015	72,000	24	28.1	61	71.7
2016	59,000	42	77.6	10	18.5

Source: (WAEC, 2016)

This might be the causes of poor retention ability of students because the report continues to revealed that most of the students cannot reproduce learning task during their final year examination. Retention is influenced by many factors. For instance, Bichi, (2002) reports that learning should improve retention while thing's that lead to confusion or interference among learned materials diseases the spread and efficacy of learning and accelerates forgetting. Retention level in relation to age has been investigated by several

researchers. Studies on retention and instruction strategy have attracted the attention of many researchers in recent years.

Factors identified among scholars and educational psychologist includes use of lecture method and inability of teachers to take into account of importance of developing the domain of students' behaviours. Affective domain is concerned with beliefs, attitudes, interest, motives, need, satisfaction, feeling, and believe. The effective disposition of the students has direct relevance in his ability to learn, in his interest in learning and his attitude toward the value of education (Osuafor, 2001). For students to develop positive attitude toward solving problems there is need to get them interested in such issues hence simulation generate interest which is affective domain. In light of the forgoing, this study is set to examine the effect of simulation model on attitude, retention and performance in qualitative analysis among secondary school chemistry students in Zaria Education Zone.

1.3 Objectives of the Study

The objectives of the study are to;

1. Examine the effects of simulation model on students' academic Performance in qualitative analysis concepts of Senior Secondary School chemistry
2. Determinethe effects of simulation model on students' retention ability on qualitative analysis concept of Senior Secondary School chemistry.
3. Investigate the effect of simulation model on students' attitudes in learning qualitative analysis concept of Senior Secondary School chemistry
4. Explore the effects of simulation model on the academic Performance of male and female students in qualitative analysis concept.

1.4 Research Questions

The following research questions guided the study

1. What is the mean difference in the academic Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method?
2. What is the mean difference in the attitude of students taught qualitative analysis concept using simulation model and those taught using lecture method?
3. What is the mean difference in the retention ability of students taught qualitative analysis concept using simulation model and those taught using lecture method?
4. What is the mean difference between the academic Performance of male and female students taught qualitative analysis concept using simulation model?

1.5 Research Hypotheses

The following null hypotheses are formulated for testing the above research questions at $P \leq 0.05$ level of significance.

HO₁: There is no significant difference in the academic Performance of students taught qualitative analysis concept using simulation model and those taught, using lecture method.

HO₂: There is no significant difference in the attitude of students taught qualitative analysis concept, using simulation model and those taught lecture method.

HO₃: There is no significance difference in the retention ability of student's taught qualitative analysis concepts using simulation model and lecture method

HO₄: There is no significant difference in the academic Performance of male and female students taught qualitative analysis concept using simulation model

1.6 Significance of the Study

This study examined the effects of simulation model on Secondary School students' academic performance, attitude and retention in qualitative analysis concepts. The result of this study might benefit students, teachers, parents, curriculum planners, textbook authors and other researchers conducting similar researcher in the following manners:

The result of finding might benefit chemistry students by improving their academic performance, attitude and retention in the subject which perhaps help them to pass the subject at credit level. Teachers may use the outcome of this study and improve on the use of variety of methods such as simulation to enhance the attainment of their lesson and to minimize the incidence of teacher dominating of lesson.

It is also hoped that the outcome of this study may influence parents to provide their children with necessary facilities for the requirement of simulation teaching and reduce pressure due to poor performance of their children at school. The study is hope to provide insight to curriculum planners on the demand of inclusion activities that prompt the use of simulation model in curriculum planning and development.

Textbook publishers may find the study useful to design activities that involve the use of simulation model to aid meaningful learning among chemistry and other science related students. Similarly, fellow researchers may hopefully use the outcome of the study to replicate it in the other study areas, improve on it or adapt it for similar studies and also add more information to the existing literature.

1.7 Scope and Delimitation of the Study

The scope of this study shall cover senior secondary school chemistry students in Zaria inspectorate zone of Kaduna State, Nigeria. However, the study was delimited to SSII chemistry students' from two (2) senior secondary schools in Zaria inspectorate zone of Kaduna State, Nigeria. The study was also delimited to practical chemistry which is the aspect that involves qualitative analysis concepts namely cations, anions, salt, dilution, residue and filtrate. The researcher is interested in investigation of cations and anions of qualitative analysis in concept of Senior Secondary School chemistry. These concepts are prescribed by NERDC for teaching at Senior Secondary School level. In addition, these concepts appeared as compulsory questions in the final year SSCE Chemistry. Research reports and chief examiners' reports of WAEC and NECO over the years revealed that such questions appeared to be among the most difficult concepts in the side of students and as such investigation in to strategies of teaching it in a simpler way to students become imperative.

1.8 Basic Assumptions

The study is based on the following assumptions:

1. Significant difference exist in the academic Performance of students in qualitative analysis concept.
2. Significant difference exist in the attitude of students in qualitative analysis concept.
3. Significance difference exist in the retention ability of students in qualitative analysis concept.
4. Significant difference exist in the academic Performance of male and female students in qualitative analysis concept.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The study is aimed at investigating the effect of stimulation model, retention and attitude on students' academic Performance in qualitative analysis. In this chapter, the literature for the study were reviewed and presented in the following sub-headings:

- Concept of Qualitative Analysis in Chemistry
- Method of Teaching Chemistry at Secondary Level
- Teaching of Practical Chemistry at Senior Secondary Schools.
- Concept of Simulation Model in Teaching Chemistry
- Attitude and Academic Performance in Chemistry
- Retention Ability in Chemistry
- Academic Performance in Chemistry.
- Gender and Academic Performance
- Overview of Similar Studies.
- Implications of Literature Reviewed to Present Study.

2.2 Concept of Qualitative Analysis in Chemistry Practical

Qualitative analysis generally refers to a systematic scheme to confirm the presence of certain usually aqueous ions or element by performing a series of reactions that eliminate ranges of possibilities and then confirm suspected ions with a confirming tests as well as.

- Chemical test and flame test.
- Litmus and filter paper.
- Apparatus such as test-tube, racket and spatula and funnel.

Qualitative analysis involves the identification of given chemical substance through analysis of their constituent ions and/or functional group (Njoku, 2007). According to Awiri, (2011) qualitative analysis determines the presence or absence of particular compound but not the mass or concentrations. Pavésic, 2008) defined qualitative analysis as a systematic scheme to confirm the presence of certain aqueous ions or elements by performing a series of reaction that eliminates ranges of possibilities and then confirm suspected ions with a confirming test.

Qualitative analysis as a practical activity was designed not just to fulfill the demands of the chemistry curriculum which insist that it should be taught as science rather it offers students a feel of scientific phenomena and foster conceptual understanding. The concept of qualities analysis can be studied under three levels namely macroscopic, submicroscopic and symbolic levels. Onwu and Randal (2006) are of the opinion that students' interest in chemistry is captured at macroscopic level as this level of representation describes the bulk of properties of tangible and visible phenomena in everyday experiences of learners. This is brought about when such learner observed the change in the properties of matter e.g change, P_H of aqueous solution formation of gases, precipitate in chemical reactions and solubility of residue and precipitate.

Submicroscopic Level is a level that provides explanation to the learners at a particular level in which matter is described as being composed of atoms, molecules and ions. While, Symbolic Level is the symbolic representation of chemical values through the use of chemical symbols, formulas and equation as well as molecular structure drawing diagram, models and computer animation to symbolize matter. In qualitative analysis, for example observation and recording of effervescence of a colorless and odorless gas that turn lime water milky and changes the blue litmus to red during qualitative analysis is associated with macroscopic level. Going further to provide

explanation that it is the carbonate salt that decomposes on heating to give colourless and odourless CO₂ gas is at submicroscopic level. However, the ability to write the correct equation for decomposition reaction is at the symbolic level of conception. Research has shown that students have great difficulty in relating what they have learnt in the macroscopic level to the submicroscopic and symbolic levels of conception (Onwu and Randal, 2006).

2.3 Methods of Teaching Chemistry at Senior Secondary

The term method means the ways and kinds of activities that teachers and students engage in the interactive process with a view to stir up and facilitating learning for accomplishing a set of instructional objectives. It also include utilization of appropriately selected curriculum materials, content and learning experiences, motivational strategies, and demonstration of knowledge of educational psychology in the teaching learning process.

Scholars such as Olurandare, (2000), Ibe and Nwosu, (2003), Danjuma, (2005), and Achor, (2008) maintained that there have been varieties of methods for teaching sciences. These methods include Demonstration, Lecture method, Project method, Inquiry Method, Discussion Method and Simulation method. Demonstration method involves showing a particular procedure or skill to the students who after careful teaching and learning and interaction repeat and practice the same process shown to them. The demonstration approach can be used when the available resources and equipment's cannot go round for all the students in the class. Its advantage include, motivating student and allow teachers to use activities could be harmful to student if carry out by them (Adedeji, 2013). This method may however, lead to the problem in seeing the details of the objectives or activities being carried out during demonstration.

Another activity-based method is laboratory activity method. The use of indoor laboratory to carry out experiment that is commonly in practice in schools today. Its advantage may include to illustrating regulative principle of chemistry, instance and development of laws, developing in student's ability to write report on laboratory exercise, and provide opportunity for students to learn how to use burette, pipette, test-tube, spatula, rasket however, the method is time consuming and makes high demands on materials and equipments.

Project method is used by teachers to individualize instructions, at times project are giving to individual or small group of students. Here, students are required to look for solutions to problems of special interest. The students obtain topic for the project work from the sources available. The teacher is expected to guide them where necessary. The project method could take a week, month, or even some years. (Wakili,2007). This method allows students to interact with their colleagues. However, the method needs proper organization and control for it to be successful. Discovery is another activity basedmethod of teaching sciences. It enables students to get experience in using facts, concepts and principles process by using mental process and manipulating equipment and materials. The method brings about intellectual attainment and a shift from an extrinsic to intrinsic reward. The discovery method is slow and time consuming. It does not lead to the coverage of large amount of knowledge within a short time.

Lecture method is another method of teaching that emphasizes "talk and chalk" in teaching of science subjects. More than 80% of scientific information and principles are delivered as lectures, James, (2000),Danjuma, (2005), Chor (2008) and Mahmud (2009).Its advantage include saves time and energy and offer easy coverage of syllabus and faster dissemination of scientific information and facts. This method may however, lead to rote learning and registration of information without necessarily aiding

understanding. For the purpose of this study, simulation and lecture method were reviewed as methods for teaching chemistry.

2.4 Teaching of Practical Chemistry at Senior Secondary Schools Level

Practical chemistry for senior secondary school is viewed by Achor, 2008 as an organized experimental study or as experimental science. According to Federal Ministry of Education 2007 practical chemistry compose into volumetric analysis i.e acid base practical which is calculations, and qualitative analysis i.e salt analysis. Conventional practical chemistry is an aspect of chemistry at the senior secondary schools syllabus, which was found to record high failure rate (Ifeako 2006).

Olurunde (2012) qualitative analyses in chemistry are two areas of chemistry endeavor. In most chemistry examinations practices are awarded forty percent which is a pointer to its importance in any chemistry examination. Qualitative analysis does not only stop at the identification of cations and anions but went further to the qualitative analysis of organic functional groups from organic compounds.

Quantitative and qualitative analysis serves as a basis of pursuit in chemistry and chemical analysis both at the research level and in the industries especially in production line. In most chemistry and chemical endeavor both quantitative and qualitative analysis are of uppermost importance as they are the core of research in chemistry. Scientists desire of scientific knowledge both for the chemical constituent of a compound or a product (qualitative analysis) and the amount or quantity of these chemical constituents (quantitative analysis) which is a vital information in chemical development, innovation, quality control and industrial activities (Adedeji, 2013). This study investigated the effect of simulation model on students' academic Performance, attitude and retention in qualitative analysis concept of practical chemistry.

2.5 Concept of Simulation Model of Instruction

A model is a human construct that helps a better understanding of real world system (Mackey, 2009). Models are teaching/learning aids used in science instruction to represent reality in order to enhance the effectiveness of teaching and improve the desired learning outcome. Models as emphasized by science educators Njoku, 2004, Don, 2001; Oyediran, 2004 Malgorzata, 2006 are of great importance in the teaching of science. Different types of models are used in order to concretize abstract concepts. Models can lead to knowledge and cognitive development of the students' e.g. models can enable the simplified version of the complex phenomenon to be produced and hence concept formation and better understanding of the issue under discourse models enable students to focus attention on certain aspect of the concepts, processes, structures and relationships being studied (Malgozata, 2006). It equally' give students experience of phenomenon that are remote, physically unavailable, cannot be brought to class or dangerous to handle. Models help to concretize difficult and abstract concepts (Njoku, 2004).

Jeng-Fung and Jeng-Chin (2009) carried out a research on the development of the simulation modeling and modeling ability evaluation in physics among secondary school students. The researchers concluded that students learned physics concept (pendulum concepts) better when exposed to using pendulum modeling than those exposed to using lecture method. Research by Ching-Huci (2012) on instructional approaches science performance, attitude and inquiry ability in a computer supported collaborating learning environment in science among public school students. He concluded that students Performance was better when exposed to using computer environment than those expose to using traditional environment. The findings further indicated that students developed positive attitude when exposed to computer environment.

Anima Sahun (2007) conducted a research on the effect of simulation environment on student Performances and attitude in mathematics among secondary School students. He concluded that students' Performance was better when exposed to using simulation environment more than those expose to traditional environment. The findings further indicated that there was significance difference in academic Performance between the male and female students taught mathematics using simulation environment.

Dori and Barak (2007) carried out a research on simulation in teaching physical chemistry: thermodynamics and statistical mechanics among students of university level. The researchers' findings revealed that students learned thermodynamics better when exposed to using simulation model (molecular modeling) than those exposed to using lecture method. A research by Lado (2010), on simulation model in teaching organic chemistry hybridization among N.C.E students concluded that students understood hybridization concept much better when exposed to using simulation model (molecular model) than those exposed to using lecture method. In this study simulation model for teaching qualitative analysis concept at SSII in order to determine its effectiveness on student Performance, attitude and retention ability in chemistry.

2.5.1 Lecture Method

In lecture method, the teacher delivers pre-planned lesson to the students with little or no instructional aids in lecture method. Lecturing, as a method, is used largely to build up basic theoretical knowledge, which must be acquired by the students before he is able to display practical skills and undertake practical tasks in the laboratory. It is highly valued in a situation where the number of students, who are benefiting from it is quite large and in a situation where there is inadequate number of competent and qualified teachers coupled with the insufficient instructional materials, lecture method with note taking technique may be more effective than any other methods. In fact, in teaching

geography, lecture method will be more effective in a very large class situation in which the teacher combines the method with the effective use of instructional materials, questioning technique and other appropriate strategies that can be employed based on the classroom situation. Okam (2009), reveal that the lecture method is used for Provision of some relevant background materials and information which bear on a topic or lesson; introducing a new different topic; Summarizing and recapitulating certain generalizations, providing supplementary information beyond what textbooks have to offer and for explaining certain theoretical principles or points which cannot be easily demonstrated

Atadoga andLakpini, (2013) stressed that lecture method is useful in imparting factual information in an efficient manner to convey facts, concepts and principles to students who have difficulty reading their texts. It is easy and convenient for the lecturer to deliver his prepared lectures without hustles of practical demonstration; also, the lecturer hardly considers the possibility of students' participation. Similarly, a good lecture can motivate, inspire, and instigates a student towards creative thinking and helps to get thinking patterns of students to be more focused. The method is convenient and suitable for carrying out a number of academic activities and responsibilities during certain occasions. Some of these activities include: (i) introducing a topic (ii) summarizing a subject-matter; (iii) giving instruction before performing any laboratory experiments; (iv) explaining complicated and difficult experiments; (v) giving historical accounts of scientific events, scientific discoveries and inventions; (vi) describing the lives of great scientists, their achievements and contributions to science.

Lecture method has no provision for activities in the method as students are reduced to he status of passive listeners. This implies limited development of scientific attitude and training.

- It does not take care of observation, experimentation, drawing inferences as there are no opportunities for students to engage in practicals
- It does not provide immediate mechanisms for ascertaining students' level of understanding and mastery of what is being taught.
- It does not cater for individual needs of students.

As noted by Bligh (2000), the standard lecture format may not be the most effective way to promote thinking and develop attitudes, but changes to lecture techniques may help to overcome such limitations. Selecting appropriate lecture techniques is also one-way to help lecturers become more effective. As such, there remains considerable scope to explore the use of technology in enhancing the delivery of, and ultimately, the learning outcomes of a lecture. This study used lecture method as an instructional strategy for teaching the control group.

2.6 Attitude and Academic Performance in Chemistry

Many educationists have emphasized the importance of developing the domain of students' behaviours. Affective domain is concerned with beliefs, attitudes, interest, motives, need, satisfaction, feeling, and believe. The effective disposition of the students has direct relevance in his ability to learn, in his interest in learning and his attitude toward the value of education (Osuafor, 2001). For students to develop positive attitude towards solving environmental problems there is need to get them interested in such environmental issues. Dageinty and Coll (2009) opined that a satisfactory grade in a class does not necessarily imply a positive attitude toward the subject. But both positive and negative attitude will influence students' performance. Danjuma (2007) observed that teacher change of attitude and use of improved instructional strategy could take of some of identified differences. In a related development James, 2012 conducted a research on the

attitudes of Nigerian students toward integrated science. He concluded that male had favorable attitude toward sciences than female. The researcher trying to investigate the effect of simulation model on gender in qualitative concept of chemistry.

Isa (2012) opined that part of developing scientifically is acquiring positive attitude. Surly science is in many respects the systematics application of some highly regarded human value ad attitude. If science is taught effectively, the result will be rein Force such general desirable human attitude and value. He further stated that to develop scientific attitude in students requires a teacher to present his lesson in an intellectually stimulating manner. By this it means that science lesson shortly not be dominated by telling the students facts alone but present their lessons with challenging situations that will make students think and carryout activities on their own. Abubakar (2010) reported that gender related differences existed in chemistry learning and performances. Female students have significantly lower self-efficacy then males with respect to chemistry related and other traditionally male dominated subject including computer. Other researchers on interrelationship of gender and chemistry have reported no significant gender influence on performance in chemistry.

Abubakar and Eze (2010) have reported that little differences are identified between males and females in chemistry performances at ages 9 through 13 years but at age 17, females perform poorer that the males.

Stanoutastis (2007) reported that younger students outperformed their peers in chemistry, English, science and overall score while older students achieved at a higher level than the youngest ones.

2.7 Retention Ability in Chemistry

Retention is product of meaningful learning when teaching is effective and meaningful to the students, (Bichi, 2002), Retention is the ability to retain and consequently remember things experienced or learned by an individual at a time. It take place when learning is coded into memory. Thus, appropriate coding of incoming information provide the index that may be consulted so that retention take place without an elaborate search in the memory lane (Bichi, 2002). The nature of the material to be coded contributed to the level of retention. Materials are related to the quality of retention in terms of their meaningfulness, familiarity, concreteness and image evolving characteristics (Adeniyi, 1997).

Several factors are known to influence retention. Bichi, (2002) reports that learning should improve retention while thing's that lead to confusion or interferenceamong learned materials diseases the spread and efficacy of learning and acceleratesforgetting. Retention level in relation to age has been investigated by severalresearchers. Studies on retention and instruction strategy have attracted the attentionof many researchers in recent years. For instance, Ezema and Dung (2003) comparedthe effectiveness of concept of mapping and guided discovery teaching strategies on students' retention of some chemistry conceptresults showed a significant differentbetween the concept of mapping and guided discovery, post-test scores in favour of concept mapping. It follows that the concept mapping method enable students to have better understanding of concept taught and retain more knowledge of chemistry concept than the guided discovery method.

Akinbobola and Folashade (2009) compared the effectiveness of constructivist teaching method and the conventional method with reference to Performance, retention and attitude. He found that students exposed to constructivist teaching method have

higher cognitive Performance, more positive attitude and higher retention level than their counter parts taught using the conventional teaching method. In this study the retention ability of students taught qualitative analysis using simulation model method investigated and compared with that of students taught same concept using conventional approach.

Okafur (2007) conducted research on effects of note taking patterns on students' academic performance, interest and retention in geography. He concluded that the students exposed to experimental group performed better and had a better retention than those exposed to lecture method.

Mahmood (2009) conducted studies on study of effect and discovery and lecture method of instruction on academic performed in gene among NCE students in biology. He concluded that the student's expose to experiment group using discovery method performed better and had a better retention than expose to control group using lecture method.

Njoku (2007) comparison of student performance he three categories of questions in SSCE practical chemistry examination. He concluded that he students exposed to experimental group performed better and had a better retention that those exposed to control group.

Olurundare (2012) conducted studies on best practice in teaching of science in secondary schools in Nigeria. She concluded that the students that exposed to experimental group performed better and had a better and had a better retention than those exposed to control group.

Pavesic (2008) science performance gender differences and experimental work in classes in Slovenia. The findings of this study have shown that the students that exposed to experimental group performed better and had a better retention than and those exposed to control group.

2.8 Academic Performance in Chemistry

According to Stephen (2002) academic Performance is a method of determining whether a successful completion has taken place for each students. Okafor (2000) on the other hand maintain that academic Performance concerns mental health care.

According to him, mental health has its basis, physical health and intellectual skills which lead to satisfactory means of adjustment, social sensitivity and adequate self-concepts. It should be noted that academic Performance is based on the degree intellectual simulation that the child could receive from learning situation. NERDC (2007) and Olurundare, (2010), revealed that the academic Performance of students in chemistry generally poor at SSS level. Annual report of both the West African Examination Council (WAEC) (2007-2010) and National Examination Council (NECO) revealed that the poor academic Performance of students in chemistry still persist. Similar report from WAEC, indicated that the result of 2010 November/December West African Senior School Certificate Examination were not encouraging as only 20.04% percent of 310,077 candidates obtained five credits in core science subject.

In a related development Sam, (2011) conducted a research of academic Performance of science students in Nigeria secondary school. Examination of past academic Performance in secondary schools indicated that in 2007, only 25.54% percent obtained five credits in core science subjects. There was a slight improvement in 2009 when 25.75% percent pas the examination, figure that went down in 2010 to 20.04% percent (Olurundare, 2010). Lado (2010) the result of its finding revealed that the poor academic performance of students in chemistry was due to the poor teaching strategies afford by the teacher Akimbola and Folashade (2009) conducted research compared the effectiveness of constructivist teaching method and the conventional method with references to performances, retention and attitude in chemistry. The result of their

findings revealed that students performed poorly academically in chemistry due to the constant use of traditional conventional method by the teachers.

Owu and Randal (2006) the result of their findings shown that chemistry students performed academically better using activity-base method in learning chemistry education. Stanoustat (2007) the result of his research findings revealed that students were academically good while using simulation method in teaching and learning of chemistry education.

There is a need for the research to investigate the effect of simulation method on academic performances of student in qualitative analysis.

2.9 Gender and Academic Performance

Gender has been identified as a very important consideration, as male and female have different views and approaches in chemistry learning. The issue of gender difference in chemistry has attracted attention of many chemistry educators and researchers (Olorukooba, 2008 and Mari (2009). Researchers have focused attention on gender differences in educational choices, as well as investigated gender differences in interest, attitude and educational performances.

Gender is a cultural construct which distinguished the role, behavior, mental and emotional characteristics between the male and the female (Wakili, 2007). According Abubakar (2010) gender is a socially defined status as roles and actions ascribed to men and women so as to distinguished who they are, what is expected of them by the society and how they are related to each other for meaningful co-existence.

Achievement test result have shown that male student were superior in sciences than the female counterparts. Abubakar and Alao, (2010) studies on gender and academic performance of college physics student were investigated where some were taught using

paper, others opaque projector and concluded that both male and female benefited. Lado (2010) conducted on the effect of teaching method, gender and academic level of pre-service COE students understanding of hybridization in chemistry. The findings shows that the male students perform better than the female's student in the area have to do with calculations.

Mari (2009) also carried out a research on gender related difference in acquisition of formal reasoning, chemata pedagogic implication of teaching chemistry. The finding shows that girls have greater verbal ability than the boys and the boys have better visual special ability than girls. From the findings it show that there may be creative tendency in both sexes.

Pavesic (2008) conducted a research on science performance, gender difference and experimental work in classes. The findings shows that male students are found to be more creative than the female students.

2.10 Overview of Similar Studies

Many scholars and researchers have used simulation model to model real life situation in various subject areas. However, in the field of Chemistry Education, notmuch research work has been carried out yet. This informed the researchers of thisresearch exercise.

Akinsola and Anemasahun (2007) in their study on the effect of simulation method and simulation game environment on students' academic Performance and attitudes to mathematics in secondary schools of Botswana using quasi-experimental design. Sample size of students' was 146 drawn from a population of 3712. They recommended that it should be incorporated in the curriculum of Mathematics. The statistical tool used analysis various for the class Tests Performance scores between

experimental and control group. The mean score of experimental group was 18.80 while that of the control group was 15.61 on the cumulative class tests. The major findings in the researcher work have shown that simulation techniques is an important method of teaching which affect students' Performance in and attitude toward mathematics.

Obeka, (2009) carried out research on Erosion Pollution Deforestation Waste Disposal Land Degradation (EPODEWALAD) and power simulation games of geographical and environmental education in Otukpo of Benue State of Nigeria. The sample size of the study was 492 drawn from population 2025. The mean score of experimental group was 62.60 while that of the control group was 49.44. From the analysis of the result presented, the findings have shown that the students exposed to EXPODEWALAD simulation method performed better than those exposed to conventional lecture method of instruction. He therefore recommended that simulation techniques was effective in engendering cognitive Performance in environmental concepts on Geography. It should be incorporated in the curriculum of geographical and environmental education.

Jeng-Fung and Jeng-Chin (2009) carried out study on the development of the simulation modeling system and modeling ability evaluation using quasi-experimental design. They made use of computer simulation pendulum and pendulum stimulation in teaching pendulum in physics at high institution of Taiwan using sample of 120 students randomly drawn from a population of 879 students. The results shows that that models enhanced the efficacy of teaching and provide students with adaptive environment which enable them to learn what they need. They recommended that simulation method was effective method of teaching Sciences and Mathematics and should be incorporated in their curriculum.

Abdulkarim, (2010) carried out research on Identification, presentation and Remediation of Errors in Topographic Map among Senior Secondary School in Zaria metropolis. The sample size of the study was 100 students drawn from population of 4190. The mean score of experimental group was 59.46 higher than that of control group 37.84. The findings of this study shown simulation models as refined the experimental group with graphical, visual and computational skills. Thereby, enabling them perform better than the control group in the test. She recommended the simulation model as importance strategy for remediate topographic errors among subject.

Paul (2012) also sought to investigate the effect of stimulation model on students' performance as well as the traditional lecture method in London. using quasi-experimental design, the researcher use one hundred and twenty (120) students as sample size of study, Sixty (60) were treated to simulation model (Experimental group) while the other sixty (60) were treated with lecture method (control group). The result of the study indicated that those treated with simulation model method did better. He recommended the simulation method as an effective teaching technique in science and technology Michael (2007) emphasized the use of models as a crucial ingredient in education. Njoko (2004) opined that simulation model technique is more effective in teaching of science and technology subjects as well as in producing desirable attitudes in students and teachers respectively.

Jiya (2012) carried out a research on modelling simulation in teaching science subjects in Andratottia. The findings of the research showed that simulation model enhances the efficacy of teaching and provide students with adaptive environment of learning.

Lee (2014) carried out a research on simulation; bringing the benefits of situated learning to the traditional classroom in Edo State. The results of the research showed that

the students exposed to simulation did better than those taught using the traditional classroom. The researcher recommended that simulation was effective in teaching and learning of science and that it should be incorporated in the curriculum of chemistry and other related subjects.

Dagher (2015) conducted a research on computer simulation as instructional method and development using quasi experimental design. The researcher made use of computer simulation in teaching genetics in biology at higher institutions of New Jersey using a sample of 100 students randomly selected from a population of 650 students. The researcher concluded that the computer simulation enhanced the efficacy of teaching science. He further recommended that simulation should be incorporated in their curriculum.

Michael (2016) carried out a study on comparison of students' product creativity using computer simulation activity versus hands on activity in technology education in Abia State. The findings showed that the students performed better while using computer simulation. He therefore recommended that simulation techniques was effective in teaching science. It should be incorporated in their curriculum.

Simulation model has been acclaimed as an indispensable teaching device by students and teachers. However, not many scholars and science teachers were aware of the device and technique of design, construction and effective use of models (Njoku, 2004). This study therefore is a contribution to knowledge to sensitize scholars and science teachers on the use of simulation model as a teaching strategy.

2.11 Implications of Literatures Reviewed to the Present Study

The write-up looked at the meaning of simulation model method and other related teaching methods and strategies. Mockey, 2009 opined the effectiveness of teaching and

improve the desired learning outcome. On the area of academic Performance, Dori, (2000); Njoku, (2004); Oyediran, (2004) and Malgorzata, (2006) in their various studies have showed simulation teaching strategy is superior to other teaching methods and strategies compared to another methods and lead to knowledge and cognitive development of the students.

Literature was also reviewed on attitude and academic Performance in science. Some researchers such as Njoku (2004), Osuarfor, (2001) and Sam (2011) conclude in their various studies that students with positive attitude perform better academically and retained more knowledge while those with negative attitude perform poorly in academic Performance.

Bichi (2000) opined students retain more knowledge in science when teaching is effective and learning is meaningful. Literature was also reviewed on retention and academic performance in biology. Mahmood (2009) conclude in his studies that the students exposed to experiment group using discovery method performed better academically and had a better retention than those exposed to control group using lecture method.

On the area of academic performance and retention in science. Olundare (2012) in her studies has showed the student 'exposed to experimental group performed better academically and had a better retention and academic performance in geography. Okafur (2007) conclude in his studies that the student exposed to experimental group performed better academically and had a better retention than those exposed to lecture method.

On the area of academic performance, attitude and retention in chemistry. Folashade (2009) concluded in his studies that the students exposed to experimentally, develop positive attitude and had a better retention than those exposed to control group.

Stanoustis (2007) opined the students performed better academically when exposed to simulation method and develop positive attitude and retain more knowledge in chemistry.

On the area of academic performances Abdulkarim (2009) shown that simulation method was better than lecture' method in effective teaching and learning of sciences. Literature was also reviewed on academic performance in Geography. Obeka (2010) concluded that simulation method was better than lecture method. On the area of simulation model as a method of teaching of sciences, Njoku (2004) concluded that simulation method was academically better than lecture method.

Literature was also reviewed on academic performance and attitude in chemistry, Lado (2010) in his study showed that students exposed to experimental group performed better academically and had a positive attitude than the control group.

On the area of simulation and academic performance, Paul (2012) concluded that the students exposed to simulation (experimental group) performed better than the control group academically in chemistry. Literature was also reviewed on performance and simulation, Jeng-Fung and Jeng-Chin (2012) concluded that the students exposed to simulation (modelling simulation) were better academically than those exposed to control group in Physics.

On the area of academic performance, interest and retention in Chemistry, Bello (2013) concluded in his studies that the students exposed to experimental group performed better academically and had retention ability more than those in the control group.

This study therefore aims at investigating the effects of simulation model, on students' academic Performance, attitude and retention in qualitative analysis concept of chemistry.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The focus of this study is to investigate the effects of simulation model on students' academic Performance, attitude and retention in qualitative analysis among Senior Secondary School students. This chapter describes methodological issues on how data were collected and administered, under the following sub-headings.

- Research Design
- Population of the Study
- Sample and Sampling Technique
- Instrumentation
- Qualitative Analysis Performance Test (QAPT).
- Students Attitude on Qualitative Analysis(SAQA)
- Validity of the Instrument
- Pilot Testing
- Reliability of the Instrument
- Data Collection Technique
- Procedure for Data Analysis

3.2 Research Design

This study adopts pretest posttest Quasi-experimental control group design. Pretest and posttest were administered to experimental and control group as recommended by Kerlinger (1973). The pretest were administered in order to determine if the two groups (experimental and control) are not difference significantly in their ability level. The subjects were assigned to experimental and control groups after administering of the

pretest using QAPT. The experimental group was exposed to qualitative analysis using simulation model method while control group was exposed to the same topic using lecture method. At the end of the treatment period posttest were administered to both groups. The groups were administered with qualitative analysis Performance test (QAPT) to assess their academic Performance. After an interval of two weeks of posttest administration, the two groups were served with the same test called post-post test to determine their retention ability. Similarly, attitude questionnaire was administered twice (pre and posttest) to assess students' attitude toward qualitative analysis. This is illustrated in Figure 3.1:

AT = Students' Attitude Instrument

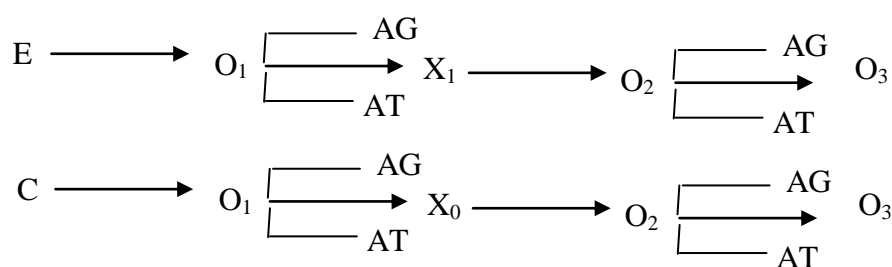


Figure 3.1: Research Design Illustrations

Key

Where

EG = Experimental group, CG = control group,

O₁ = pretest, O₂ = posttest, O₃ = post-posttest

X₁ = treatment, X₀ = no treatment

A_c = Academic Performance Instrument, A_t = Attitude

3.3 Population of the Study

The population of the study comprised of eight (8) government-owned Senior Secondary Schools in Zaria inspectorate zone with a total number of six hundred and forty five (645) SSS II chemistry students. The schools are co-educational, running similar curriculum and publically owned. A detail of the population is shown in Table 3.1.

Table 3.1: Population of the Study

S/N	SCHOOL	Male	Female	Total
1	G.S.S Tukur-Tukur, Zaria	165	85	250
2.	G.S.S. Dinya	85	65	150
3.	G.S.S. Tudun Saibu	22	19	41
4.	G.S.S Magajiya	20	15	35
5.	G.S.S Kugu	25	15	40
6.	G.S.S. Likoro	15	10	25
7.	G.S.S Aminu	38	23	61
8.	G.S.S. Awai	29	14	43
	Total	399	246	645

Source (Kaduna State Ministry of Education, 2014)

3.4 Sample and Sampling Techniques

Zaria Inspectorate Division Comprises Schools in Zaria, SabonGari and Soba Local Government Areas. Two Senior Secondary Schools out of eight in Zaria Inspectorate Division were selected for the study. The systematic sampling technique involved picking of schools with odd numbers where four schools namely G.S.S. Tukur-Tukur, G.S.S. Tudun Saibu, G.S.S Kugu and G.S.S. Aminu were selected and pretested.

A Qualitative Analysis Performance Test was administered to (SSII) students in the four schools selected to determine their equivalence in terms of academic performance. This was achieved by subjecting the students test scores to Analysis of Variance (ANOVA) and Scheffe's test. Two schools were purposely selected based on the fact that their mean scores were not significantly different with intact SS II classes used giving a sample size of one hundred and two students as presented in Table 3.2.

Table 3.2: Sample for the Study

S/N	SCHOOL	Status	Male	Female	Total
1	G.S.S. Tudun Saibu	Experimental	22	19	41
2	G.S.S Aminu	Control	38	23	61

3.5 Instrumentation

Two instruments namely Qualitative Analysis Performance Test (QAPT) and Students Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ) were developed by the researcher and used for data collection.

3.5.1 Qualitative Analysis Performance Test (QAPT)

This is a thirty items Performance test developed from qualitative analysis concept in area of identification of cations and anions. The instrument is a 30-item multiple choice question with four alternatives A-D developed by means of Table of specification with emphasizes on just three levels from six taxonomies of Bloom (1970). The QAPT was used in the experimental and control groups at pretest and posttests levels.

The Table of item specification for QAPT was presented in Table 3.3

Table 3.3: Table of Specification for QAPT

Content	Weight (%)	Knowledge (25)	Comprehension (25)	Application (10)	Total (100)
Salt	(10)	2	2	1	5
Dilution	(10)	2	2	1	5
Residue	(40)	4	4	2	10
Filtrate	(20)	4	4	2	10
Total	(100)	20	5	5	30

Source (adapted from Obeka, 2009)

3.5.2 Students Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ)

The Questionnaire was developed by the researcher to determine the students' attitude toward qualitative analysis. The instrument is written in both positive and negative form and it consist item which is developed based on the Likert-type five-point scale of Strongly Agree (SA), Agree (A), undecided (UD), Strongly Disagree (SD) and Disagree (D) respectively. The same questionnaire were administered to experimental

and control group before and after exposed to qualitative analysis in order to determine if there is any change in the students' attitude toward qualitative analysis concept. Details are presented in appendix C.

3.5.3 Validity of the Instruments

The QAPT and SAQACQ were presented to three experts in Science Education, and Educational Psychology and Counseling Departments, with a minimum qualification of Ph.D in Ahmadu Bello University, Zaria, for validation.

The experts were requested to critically examine and assess all items of the instruments paying attention to the following. Whether;

- i. The items test what they are meant or not.
- ii. The language expression is simple clear, precise and free from ambiguity. Thus the scholars discovered that the grammar was faulty and recommended for thorough editing.
- iii. The questions match the ability of students' or not.
- iv. The question adequately covers the syllabus or not.

The experts made constructive criticism and corrections. For the Qualitative Analysis Performance Text (QAPT) only one question was cancelled and modified in the question paper in the case of simulation Performance test.

3.5.4 Pilot Testing

The instruments were pilot tested, before the final administration to the sample. A sample of 30 SSII students' at GSS Zaria (SNR) were used to pilot tested the two instruments. The school formed part of the population and not the sample for this study. Qualitative Analysis Performance Text (QAPT) was administered twice using test-retest

method while attitude questionnaire were administered once. The purpose of the pilot study according to Bichi (2002) is to:

- i. Determine the reliability of the instrument before the administration (QAPT) and questionnaire.
- ii. Assess the feasibility of the study before trial.
- iii. Determine the appropriate of time duration which the subject would need to answer.
- iv. Identify problem or difficult that respondent may encounter with a view to eliminate them.
- v. Reliability of the test item will be determined using students' scores.

3.5.5 Reliability of Instruments

The reliability of the instruments for this study were carried out with the result of pilot testing. The test-retest method using the Pearson Product Moment Correlation Coefficient statistic was used to determine the reliability of the Qualitative Analysis Performance Test (QAPT). The same test was administered on two different occasions at two weeks interval as recommended. The scores from the two administrations were correlated as an estimate of the reliability of the test (Sambo, 2008). The reliability coefficient of QAPT after correlation was 0.66, showing that the instrument is reliable and was used for data collection in this study.

The reliability of Students' Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ) was determined using Cronbach's Alpha. The reliability coefficient of SAQACQ was 0.96 which according to George and Mallery (2003) is an excellent tool based on their rule of thumb ($\alpha > .9 = \text{Excellent}$, $\alpha > .8 = \text{Good}$, $\alpha > .7 = \text{Acceptable}$, $\alpha > .6 = \text{Questionable}$, $\alpha > .5 = \text{Poor}$, and $\alpha < .5 = \text{Unacceptable}$). showing that the instrument is reliable.

3.5.6 Items Analysis

Item analysis was carried out from the pilot testing result to determine the item difficulty, and discrimination indices. Item difficulty is a measure of percentage of students who got the item correct divided by the total number of students that attempted the item. Sambo (2008), recommended for acceptance of items with difficulty index between 40% to 60%, and modifying or rejecting items with difficulty index below 40% for they are considered being too easy, and 60% being too difficult (Appendix D).

The discrimination index of the test is the ability of the test item to distinguish between high and low-ranking students in the test.

Sambo (2008) is of the opinion that items of discrimination index of 0.40 and above are very good for the study, 0.30 – 0.39 are reasonably good, 0.20 – 0.29 are marginal items that need improvement, while items with discrimination index of 0.19 and below are poor items to be discarded (Appendix D).

3.6 Administration of Treatment

The treatment for the experimental group were administered by the researcher with the aid of Qualitative Analysis Simulation Package (QASP) which is a tool developed by the researcher to treat subject in experimental group as shown in figure 3.2 and in Appendix G. The Structure of administering the Simulation Package has the Following Steps.

- i. Identification of real components of a substance (salt)
- ii. Chemical/apparatus use.
- iii. Instructional content delivery.
- iv. Outcome
- v. Evaluation

vi. Review stage

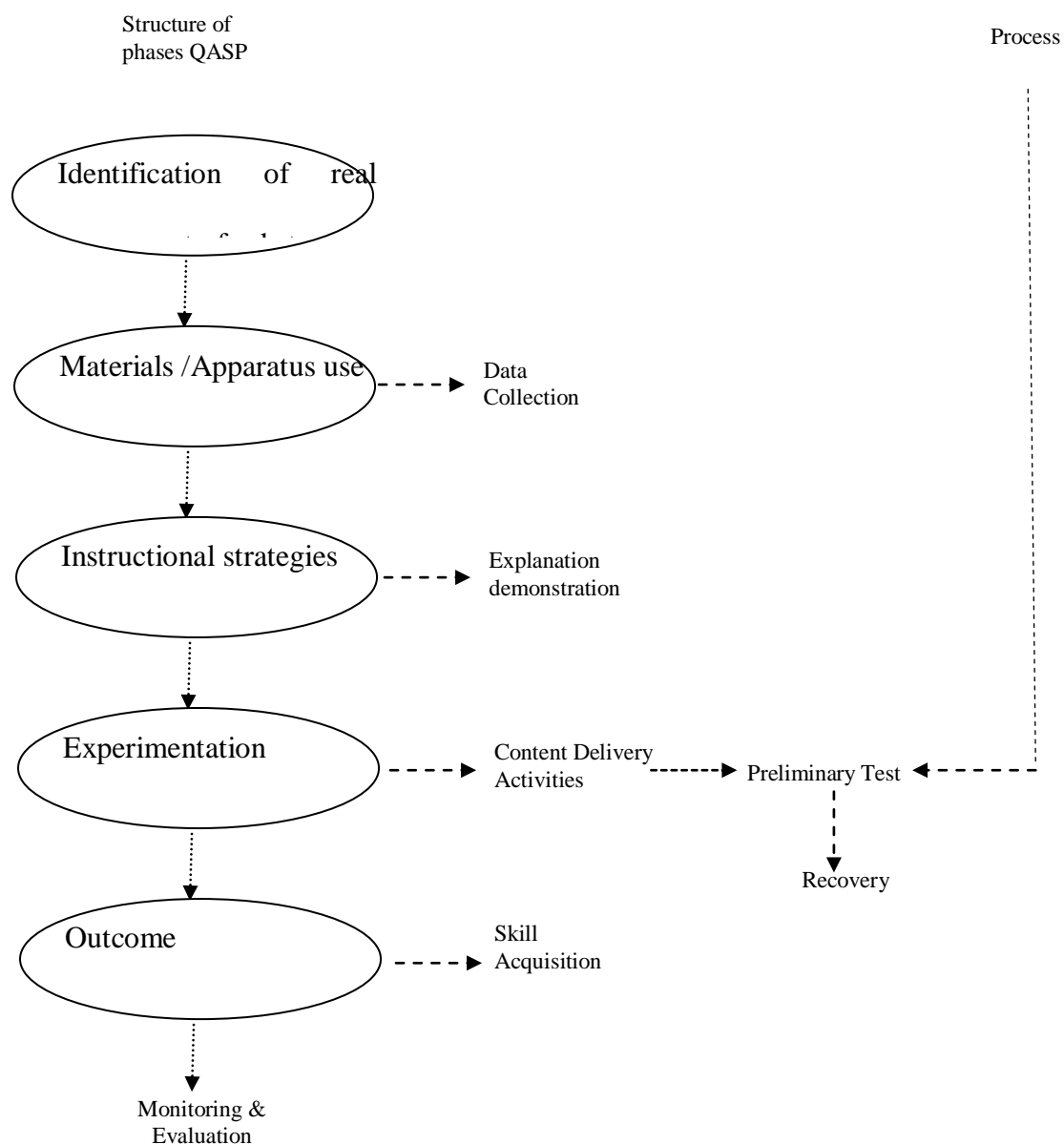


Figure3.2: Qualitative Analysis Simulation Flow Chart
Source: (Adopted from Abdulkarim, 2010)

In the introductory stage of content delivery, concept of qualitative analysis was introduced. The skills of identifying real components of a substance will be shown to the students. Students are made to understand the application of such skills in identification of real components of any given substance.

Students were exposed to the appropriate chemical reagents that could be used to identify cations and anions in a given substance. The right quantity of such reagents in identifying the components of salt. The instruction stage explain the Concept in identifying cations and anions in a given substances. Students are allowed to interact and discuss with instructor. Activity stage engages students in laboratory instructions through demonstrations, discussion and qualitative analysis exercises.

Simulation phase allow the students to translate the abstract ions present in a given substance into their chemical symbols and equations using mathematical simulation. Hardware refer to computer model showing an aspect of dissociation of a compound into ions and simulate the movement ions in the solution. Next is Assessment phase to determine students' Performance in qualitative analysis after treatment with QAPT evaluation phase.

The QAPT leads itself to two forms of evaluations, formative and summative. The formative evaluation enables modifying, revising and improving the instructional strategies. For example there could be solubility of salt, chemical symbols and their charges. The summative evaluation is an impact evaluation of QAPT. In summary, the evaluation made use of the assessment data students' test result as a yardstick of measure. Review phase is an extension of evaluating the efficacy of QASP in relation to how it can be used to reduce the students' failure in an external examination. It enables the researcher assess the suitability of QASP as an instructional strategy for teaching qualitative analysis concepts. It also lead itself to being revised or adopted by other researchers.

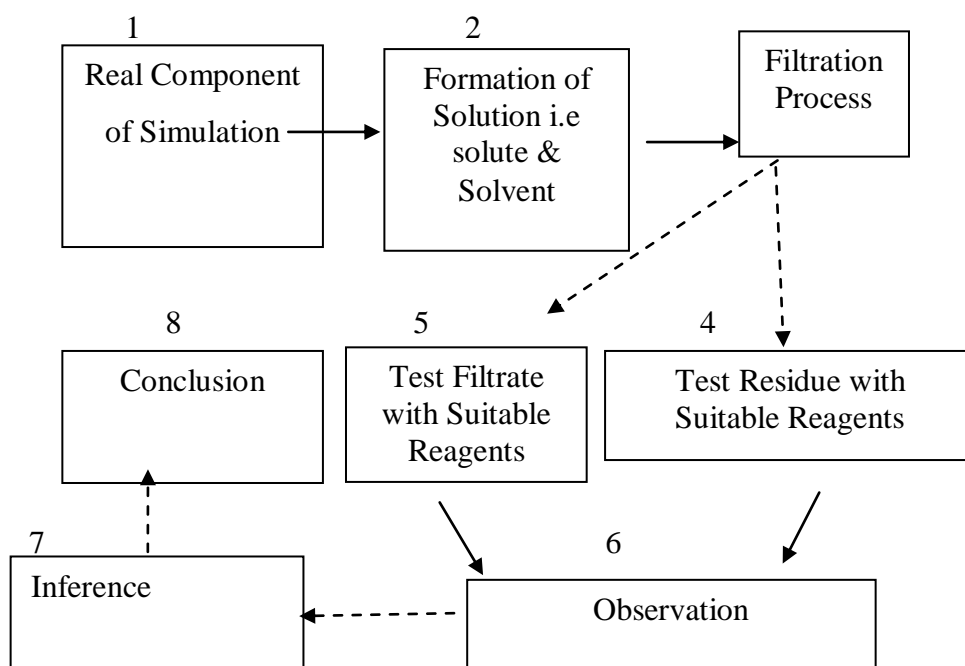


Figure3.3: Simulation Processes
Source: (Adapted fromObeka, 2009)

3.6.1 Teaching the Control Group

The teaching of control group was done by the researcher by means of lecture method. Pretest was administered to the group to determine their previous knowledge related to the concepts. In each lesson, the teacher dominates the lesson while students participate less. Posttest was administered to establish students’ performance and attitude. After a period of two weeks, posttestwas further administered to determine the retention abilities.

3.7 Data Collection Technique

Two instruments were used for data collection namely Qualitative Analysis Performance Test (QAPT) and Students’ Attitudes on Qualitative Analysis Questionnaire (SAQAQ). QAPT was used as pre-test,posttestand post-posttest to establish performance and retention ability of students in qualitative analysis, while SAQAQ was given to the experimental group as attitude pretest and attitude posttest.

3.8 Data Analysis

The research questions were answered descriptively using mean, and standard deviation, while the Null Hypotheses were tested at $p < 0.05$ levels of significance using t-test. Specifically, the following statistical techniques were employed:

1. What is the mean difference in the academic Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method?

Mean, and standard deviation of academic Performance of students exposed to qualitative analysis concept in experimental and control groups were determined.

2. What is the mean difference in the attitude of students taught qualitative analysis concept using simulation model and those taught using lecture method?

Mean, and sum of rank of post-attitude test of students exposed to qualitative analysis concept in experimental and control groups were determined.

3. What is the mean difference in the retention ability of students taught qualitative analysis concept using simulation model and those taught using lecture method?

Mean, and standard deviation of post-test academic Performance of students exposed to qualitative analysis concept in experimental and control groups were determined.

4. What is the mean difference between the academic Performance of male and female students taught qualitative analysis concept using simulation model?

Mean, and standard deviation of post-test academic Performance of male and female students exposed to qualitative analysis concept in experimental groups were determined.

H₀₁: There is no significance difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method.

This hypothesis was analyze using independent t-test.

H₀₂: There is no significance difference in the attitude of student's taught qualitative analysis concept using simulation model and those taught lecture method.

This hypothesis was analyze using Kruskalwalis H-test

H₀₃: There is no significance difference in the retention of qualitative analysis concept using simulation.

This hypothesis was analyze using independent t- test.

H₀₄: There is no significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation.

This hypothesis was analyze using independent t-test

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

The focus of this study is to investigate the effects of simulation model on students' academic Performance, attitude and retention in qualitative analysis among Senior Secondary School students. This chapter presented the result, analysis and discussions of findings.

4.2 Results

This section presented the result and interpretation by answering research questions using mean and standard deviation and testing null hypotheses using t-test statistic and Kruskal Wallis at 0.05 level of significance as follows:

Answering Research Questions

RQ1: What is the mean difference in the academic Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method?

To answer this question, mean and standard deviation of posttest academic performance of experimental and control groups were used and presented in Table 4.1:

Table 4.1: Means and Standard Deviations of Post Test Academic Performance for Experimental and Control Groups

Variable	N	Mean	S.D	Mean difference
Experimental	41	59.2	10.5	26.7
Control	61	32.5	11.5	

The Table 4.1 presented the mean and standard deviation of academic performance of experimental and control groups. From the result, experimental group recorded a means of 59.2 with standard deviations of 10.5, while control group recorded a

mean of 32.5 and standard deviation of 11.5. Students from experimental group performed better than control group with mean difference of 26.7. The mean difference is as a result of application of treatment and therefore simulation package proved to be effective in enhancing students' academic performance.

RQ2: What is the mean difference in the attitude of students taught qualitative analysis concept using simulation model and those taught using lecture method?

Table 4.2: Means and Standard Deviations of Post-Attitude of Experimental and Control Groups

Variable	Test	N	Mean	Sum of Rank	Differences
Experimental	Post-test	41	55.6	2279.6	24.2
Control		61	31.4	1915.4	

The Table 4.2 presented pretest and posttests mean and sum of Rank of attitudinal change of students in experimental and control group. The post test result shows that, students in experimental group recorded a mean of 55.6 while control group has a mean of 31.4 with difference of 24.2 against control group. This shows that students in the experimental group developed more positive attitude than control group. The mean difference is as a result of application of treatment and therefore simulation package proved to be effective in enhancing students' attitude towards chemistry.

RQ3: What is the mean difference in the retention ability of students taught qualitative analysis concept using simulation model and those taught using lecture method?

Table 4.3: Means and Standard Deviations of Post-Posttest Performance Scores of Experimental and Control Groups

Variable	N	Mean	S.D	Mean difference
Experimental	41	55.6	9.4	29.2
Control	61	26.4	10.2	

The Table 4.3 presented the mean and standard deviation of retention ability of experimental and control groups. From the result, experimental group recorded a means of 55.6 with standard deviations of 9.4, while control group recorded a mean of 26.4 and standard deviation of 10.2. Students from experimental group retained qualitative analysis concept of Senior Secondary School chemistry better than control group as mean difference of 29.2 were recorded. The mean difference is as a result of application of treatment and therefore simulation package proved to be effective in enhancing students' retention ability.

RQ4: What is the mean difference between the academic Performance of male and female students taught qualitative analysis concept using simulation model

Table 4.4: Means and Standard Deviations of Male and Female Students in the Experimental Group

Variable		N	Mean	S.D	Mean Differences
Experimental	Male	22	29.2	7.5	0.8
	Female	19	30.0	8.1	

The Table 4.4 presented the mean and standard deviation of male and female students in the two groups. From the result, male students in experimental group recorded a mean of 29.2 while female students have a mean of 30.0 with difference of 0.8. Female students show a slight difference over male ($30.0-29.2=0.8$). The mean difference may be due to gender of students as a result of application of treatment.

Testing Null Hypotheses

Ho1: There is no significance difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method.

Table 4.5: t-test Analysis of Posttest Academic Performance Mean Scores of Experimental and Control Groups

Variable/Performance	N	Mean	S.D	df	t.cal	t.crit	P	Remark
Experimental	41	59.2	10.5	100	2.34	1.98	0.00	Significant
Control	61	32.5	11.5					

Significant at $df = 100, P < 0.05$

Table 4.5 presented the mean and standard deviation and t-test analysis of significance difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method. From the result, the t-cal 2.34 was greater than t-crit of 1.98 at degree of freedom of 100. The null hypothesis which stated that there is no significant difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture methods rejected. This is because the t-calculated is greater than t-critical.

Ho2: There is no significance difference in the attitude of student's taught qualitative analysis concept using simulation model and those taught lecture method.

Table 4.6: Mann-Whitney test of Attitude Change of Experimental and Control Groups

Variable/Attitude	N	Mean	Sum of Rank	U	P	Remark
Experimental	41	55.6	2279.6	985	0.04	Sig.
Control	61	31.4	1915.4			

Significant at $P < 0.05$

The Table 4.6 presented posttests means score, sum of Rank and Mann-Whitney of attitudinal change of students in experimental and control groups. From the result, students in experimental group recorded a mean of 55.6 while control group has a mean of 31.4 with difference of 24.2 against control group. The Mann-Whitney (U-test)

obtained is 985 and p-value of 0.04. There is significant difference in the attitude of students taught qualitative analysis concept using simulation model and those taught lecture method, the null hypothesis is rejected. The hypotheses was rejected because the p value of 0.04 is less than 0.05 level of significance.

Ho3: There is no significance difference in the retention of qualitative analysis concept using simulation and lecture method.

Table 4.7: t-test Results of Post-Posttest Performance Scores of Experimental and Control Group

Variable	N	Mean	S.D	df	t-cal	t-crit	p	Remark
Experimental	41	55.6	9.4	100	2.58	1.98	0.01	Significant
Control	61	26.4	10.2					

Significant at $df = 100, P < 0.05$

The Table 4.8 presented the mean, standard deviation and t-test of retention ability of experimental and control groups. From the result, experimental group recorded a means of 55.6 with standard deviations of 9.4, while control group recorded a mean of 26.4 and standard deviation of 10.2. The t-cal 2.58 was greater than t-critical 1.98. The null hypothesis which states that there is no significant difference in the retention of qualitative analysis concept using simulation and lecture method is rejected because the t-calculated was greater than the t-critical.

HO4: There is no significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation.

Table 4.8: Means and Standard Deviations of Male and Female Students in the Experimental Group

Variable	Gender	N	Mean	S.D	Df	t-cal	t-crit	P	Remark
Experimental	Male	22	29.2	7.5	39	1.02	2.04	0.06	NS
	Female	19	30.0	8.1					

NS – Not significant

The Table 4.8 presented the mean and standard deviation of academic Performance of male and female student's taught qualitative analysis concept using simulation. From the result, male students in experimental group recorded a mean of 29.2 while female students have a mean of 30.0 with difference of 0.8. Female students show a slight difference over male ($30.0-29.2=0.8$). The t-calvalue of 1.02 is less than t-crit value of 2.04 implying that no significant exists between male and female students taught qualitative analysis concepts using simulation. This is an indication that teaching with simulation is gender friendly. The null hypothesis which states that there is no significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation exist is retained because t-calculated value is less than the t-critical value.

4.3 Summary of Findings

- i. Students taught qualitative analysis using simulation model performed better than those not exposed to the simulation model. The effect of the treatment on academic performance was statistically significant.
- ii. Students taught using simulation model developed more positive attitude towards qualitative analyses than those taught using lecture method.
- iii. Students taught using simulation model retained qualitative analysis concepts of Senior Secondary School chemistry better than those in the control group.
- iv. Effect of simulation model on male and female students' academic performance is favourable to both sexes.

4.4 Discussion of the Results

In Table 4.1, research question one shows that Students from experimental group performed better than control group with mean difference of 26.7. Similarly Null hypothesis number one is rejected because there is significant difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method. The findings of this study is in agreement with that of Dori, (2000), Njoku, (2004) Oyediran, (2004) and Malgorzata, (2006) who in their various studies showed simulation method enhances academic performance, knowledge and cognitive development of the students.

In Table 4.2, Research Question number two shows that students in the experimental group developed more positive attitude than control group. In addition, Null hypothesis number two is rejected as there is significant difference in the attitude of students taught qualitative analysis concept using simulation model and those taught lecture method, the null hypothesis. Njoku (2004), Osuarfor, (2001), Sam (2011) and Paul (2012) stated that simulation model technique is more effective in teaching of science and technology subjects as well as in producing desirable attitudes in students and teachers respectively.

From the finding of Table 4.3, research Question Number three proved that Students from experimental group retained qualitative analysis concept of Senior Secondary School chemistry better than control group as mean difference of 29.2 were recorded. In the t-test analysis, Null hypothesis number three is also rejected because there is significance difference in the retention of qualitative analysis concept using simulation and lecture method. The finding is in agreement with that of Francis and Nathaniel (2002), Akinsola and Anemasahun (2007) who revealed that simulation

techniques are an important method of teaching which affect students' retention than traditional lecture method.

From the findings of Table 4.4, Research question number four revealed that, Female students in experimental group show a slight difference over male (30.0-29.2=0.8). Male students in the control group show remarkable difference (19.0) over female students (13.0) and the difference is 6.4 against female students. In addition, null hypothesis number four is retained due to inexistence of significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation. The findings of this study is in agreement with that of Jeng-Fung and Sen-Chin (2009)Obeka, (2009)and Abdulkarim, (2010) who in their separate findings shows that male and female students exposed to innovative strategy may not differ in their academic performance. This is an indication that teaching using simulation helps in improving the performance of both male and female students.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusion, recommendations, contribution to knowledge and suggestion for further study among others in the following order:

5.2 Summary

This study examined the effects of simulation model on students' academic Performance, attitude and retention in qualitative analysis among Senior Secondary School students. The study is presented in five chapters. The chapter one presented the background, statement of the problem, research question and hypotheses. One of the factors that prompt the study is persistent failure of students in SSCE due to poor attitude generating low retention among learners. In line with this, four research questions and hypotheses were developed.

The chapter two reviewed literature on the following sub concepts: Teaching of Practical Chemistry at Senior Secondary Schools; Method of Teaching Chemistry at Secondary Level; Concept of Simulation Model in Teaching Chemistry; Concept of Qualitative Analysis in Chemistry; Attitude and academic Performance in Chemistry; Retention ability in Chemistry; Academic Performance in Chemistry and Gender and Academic Performance.

Chapter three examined the methodology of the conduct of the study. The study adopts pretest posttest Quasi-experimental control group design. The population of the comprised of eight (8) governments-owned Senior Secondary Schools in Zaria inspectorate zone with a total number of six hundred and forty five (645) SSS II chemistry students. The schools are co-educational, running similar curriculum and publically owned. Two Senior Secondary Schools out of eight in Zaria Inspectorate

Division were systematically selected for the study. In the school selected, intact SS II classes were used from two forming a sample size of one hundred and two students. Two validated instruments namely Qualitative Analysis Performance Test (QAPT) and Students Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ) were developed by the researcher and used for data collection.

Chapter four focus on data analysis and discussion. All research questions were answered using mean and standard deviation, while t-test and Mann-Whitney U test were used in testing null hypotheses. Result lead in rejecting null hypotheses number one, two and three because there were significant differences in all cases. However, Null hypothesis number four was retained due to inexistence of significance difference in the academic Performance of male and female students taught qualitative analysis concept using simulation.

5.3 Summary of the Major Findings

Since both research questions and hypotheses are geared toward addressing similar issue, the following section summarized the result of major findings:

- i. There is significant difference in the Performance of students taught qualitative analysis concept using simulation model and those taught using lecture method in respect of experimental group ($p = 0.00$).
- ii. There is significant difference in the attitude of students taught qualitative analysis concept using simulation model and those taught lecture method, against control group ($p = 0.01$).
- iii. There is significance difference in the retention of students in qualitative analysis concept using simulation and lecture method ($p = 0.04$)
- iv. There is no significance difference in the academic Performance of male and female student's taught qualitative analysis concept using simulation ($p = 0.06$).

5.4 Conclusion

This study concluded that:

- i. Simulation method is an effective method for improving students' academic performance;
- ii. Students exposed to simulation developed more positive attitude than control group;
- iii. Students from experimental group retained qualitative analysis concept of Senior Secondary School chemistry better than control group;
- iv. Simulation in teaching favor both gender as there is no difference in the performance of male and female students in experimental group and therefore it is gender friendly.

5.5 Contributions to Knowledge

By and large, the result of this study contributes to the body of knowledge in the following ways:

1. The study was able to establish that when simulation model were employed in teaching chemistry, it improves performance in qualitative analysis.
2. Simulation strategy can be used to inculcate positive attitude of students towards chemistry.
3. It was also established that the use of simulation promote retention of chemistry concepts.
4. Issue of gender disparity in teaching can be minimize using simulation model as its utilization is gender friendly than lecture method.
5. The simulation package and lesson plan developed by the researcher can be used in teaching chemistry or can be adopted in some other related field of study to

enhances performance, retention, attitude and take care of gender differences in our schools.

5.6 Recommendations

This study cannot be concluded without recommending that:

1. The Federal and state ministry of education should provide relevant materials in secondary schools for developing and implementing simulation teaching to enhance attitude and performance of students.
2. Secondary school teachers should be trained by the teacher training institutions on developing and utilization of simulation methods in teaching.
3. The Curriculum development body in Nigeria should consider inclusion of simulation method and simulation package developed by this research in teaching other science subjects.
4. Fund should be guaranteed by the Federal Ministry of Education for experts such as professional in the field of developing software and models to developed simulation soft wares for teaching chemistry.
5. Professional bodies such as STAN and Teacher training institute such as NTI should frequently organize workshop and other training programmes for teachers to use simulation methods in teaching.
6. There is a need for Ahmadu Bello University Zaria to consider the outcomes of this research and improve on the package developed for training teachers on using simulation in teaching.

5.7 Limitations of the Study

By and large, this study has some limitations that hinder its scope for generalization because:

- i. It used only Public secondary schools in Zaria Education zone without including private ones.
- ii. It did not cover tertiary institutions where chemistry is taught.

5.8 Suggestions for Further Studies

Considering the observed limitations that hinder its scope for generalization of this study, the researcher recommended that:

- i. Similar study should be conducted on the effect of simulation methods on performance, attitude, retention and motivation in public and private secondary schools in Nigeria.
- ii. Similar studies should be conducted on effect of simulation methods on performance, attitude and retention in Chemistry, Biology, Physics and Geography among undergraduate students of ABU Zaria.

REFERENCES

- Ababio, O.Y (2002) *New School Chemistry for Senior Secondary School Textbook*. Third Edition. Ibadan, Nigeria: Africana Fep Publishers Ltd.
- Abdulkarim, B. (2010) *Identification, Presentation and Remediation of Errors in Topographic Map among Senior Secondary School in Zaria Metropolis*. Unpublished PhD Dissertation ABU, Zaria
- Abubakar R.B and Alao, A.A (2010).Gender and Academic Performance of College Physics Students, A Case Study of Department of Physics! Computer Science Education Federal College of Education (Technical) Omoku Nigeria.*Journal of Research in Education and society: International Perspective*,1, 129-137.
- Abubakar R.B and Ejimaji, E.U (2010).Gender Difference in Academic Enrolment Gaps of College Chemistry Students.*Int. Journal of Economic and Development Issues*, 1,129-137.
- Abubakar, R.B. (2010). Correlate of academic performance and mathematics achievement of University undergraduate students. *Journal of Mathematics, Science and Technology Education*, 3(4), 363-371.
- Abubakar, R.B. and Eze, N.I. (2010).Breaking the gender barrier in enrolment and academic achievement of science and mathematics students.*Journal of pure and applied science education*, 1(1)m 12-20.
- Achoa E.E. (2008) *Repositioning Physics Teaching and Learning in Secondary Schools in Benue State*. Focus in Strategies for Teaching Difficult Concepts.Workshop, Materials on Retaining for Maximum Efficacy in Secondary School by Benue State Ministry of Education, Pp. 178-187.
- Adane L. and Adnese A. (2011).Relevance and Safety of Chemistry Laboratory Experiments from Students' Perspective.A Case Study at Limma University, Southwestern Ethiopia. *Educational Research* 2(12) 174-175.
- Adedeji S. A, (2013) *Chemistry Quantitative and Qualitative Analysis*, Published by National Mathematics Centre, Abuja. Pp 3
- Adeniyi, E.O (1997).Science as a Way of Knowing N.S.S.S.P Experience.*Proceedings of STAN Conference 1*, 12-17.
- Adesokan C.O. (2002) *Students Attitude and Gender Determinants of Performance*.Unpublished B.Ed Project Chemistry of Nigeria.
- Adeyegbe S.C. (2005).In Research for Indices for Measuring the Standard of Education: A Need for Shift to Paradigm. *A Special Seminar by West African Examination Council Congress, 7th May*.
- Ageinty, J. and Coll, E. (2009).*Computer based instructional methods and development*. New Jersey, Prentice Hall.

- Aghadiunu M.C.K. (1992) *A Path-Analyze Study of Cognitive Style*. Understanding of Science and Attitudinal Variables as Correlates of Performance in Chemistry. Unpublished Ph.D Thesis University of Ibadan, Ibadan.
- Ajuju P. (2005). Comparison of Effectiveness of three Methods (Advance Organizers, Discovery and Lecture Method). *Journal of Vocational Science and Educational Development* 1, 20-25.
- Ajuju P. (2007) *Teaching Method Across Discipline*. Higher Online Publication.
- Ajuju P. (2009). Evaluation of Science Teaching in Secondary Schools. *Journal for Science Education*, 1 (2) 119-129.
- Akinbobola, A.O and Folashade, A (2009). *Constructivist Problem Based Learning Technique and the Academic Performance of Physical*.
- Akinsola M.K. and Animasahun I.A. (2007). The effect of Simulation and Simulation Game Environmental on Students' Performance and Attitude to Mathematics on Secondary Schools. *The Turkish Online .Journal of Educational Technology* 6: (33)1306-6524.
- Alessi, S.M and Trollip, S.R (1991) *Computer Based Instruction: Method and Development*, New Jersey: Prentice Hall.
- Alessi, S.M and Trollip, S.R (2001) *Multimedia for Learning: Methods and Development* (3rd Ed). (214, 254 -257), Boston: Allyn and Bacon.
- Animasahun, H.B. (2007). Effect of Simulation environment on students' performance and attitude in Mathematics among secondary school students. *A Journal for Science Education*, 4(1), 121-200.
- Anu, M, (1997) *Introduction to Modelling and Simulation*. Proceeding from the 1997 Winter's Simulation Conference eds. And Radottiaskoj Healy, D.H. Winters and B.L.Nelson
- Atadoga, M.M. and Lakpini, M.A. (2013). *A Handbook on Science for Effective teaching and learning process of the subject, Nigeria educational forum*, 19(1), 23-28.
- Awiri, E. (2011). Approaches for Effective Teaching of Chemistry in Nigeria Secondary School. *Journal of Research in Education and Society* 12: (1).0-1.
- Azekwe O. (2001) *Environmental Pollution Hazard and its Implication in Anambra State*. National Light. Wednesday March 3-6pm.
- Azuka, F. N (2003) *Enhancing Student Performance Using Computer Aided Instruction (CAI) in Tertiary Institutions*. Proceedings of the 44 Annual Conference of STAN, 1, 89-96
- Bello, M. (2015). *Quantitative and Qualitative Analysis of Practical Chemistry* 1st Edition

- Berge, C., Bergen Dahl, V., Lundberg, B. and Tibeil, L. (2003) Benefiting from an Open-Ended Experiment. A Comparison of Attitudes to and Experiment. *International Journal of Science Education*; 35,359-372.
- Bichi, S.S (2002) *Effects of Problem Solving Strategy in Nigerian Primary Schools*. Unpublished Associate ship Thesis, University of London.
- Bichi, S.S. (2002). *Effects of Problem Solving Strategy and Enhanced Curriculum on Secondary School Students Performance in Evaluation Concepts*. Unpublished PhD Dissertation A.B.U., Zaria.
- Bligh, H.B. (2000). *Science education in Nigeria*. Lagos: Nigeria.
- Chandrasegaran, A. (2007). The Development of Two Tier Multiple Choice Diagnostic Instrument of Evaluating Secondary School Students Ability to Describe and Explain Chemical Reason using Multiple Level of Representation: *Chemistry Education Research and Practice* 8: (3), 283-307.
- Chinc-Huci, H. (2012). Instructional Approaches, Science Performance, Attitude and Inquiry ability in a computer supported collaborating learning environment in science among public school students. *A Journal for Science Education*, 3(2), 219-300.
- Chor, A.J. (2008). The relationship between self-beliefs, academic background and achievement of adolescents. *Asia-American Students' Child Study Journal*, 2(7), 95-111.
- Danjuma, I.M. (2005). *An Investigation of Pre-Service Teachers problem Solving Behaviour in Solving Selected Numerical Problems in Chemistry*. Unpublished PhD Thesis ATBU, Bauchi.
- Dehroux, I. (2007). *The Effect of Guided Questioning on Students Performance, Self-Efficacy in Biology for Non-Major Class*. Unpublished PhD Dissertation. The Florida University College of Education.
- Dewey, J. (2005) *Thinking Technology "in Educational Technology*.
- Don, R.B. (2001). Environmental pollution hazards and its implication in Anambra State. National Light, Wednesday, March, 14th, p 3-6.
- Dori and Barak (2007). *Virtual and Physical Molecules Modeling: Postering Model Perception and Special Understanding Educational Technology and Society* 4 (1)146-152.
- Duffy, T. and Cunningham, D (1996) *Constructivism: Implications for Design and Delivery of Instruction*. In D Jonasen (ED) Handbook of Research on Educational Communications and Technology. New York: Simon & Schuster.

- Duggins, S. (2002) “*Constructivism 34(4), 34-37 in soft were 2002 Engineering*”. In Proceeding of the 2002 American Society for Engineering Education South Eastern Section Annual Conference, Gainesville, Florida, April 2-9
- Ezelion, B. (2009), Nurturing Young Chemists. *Science Teachers of Nigeria (STAN) Chemistry panel series 4*.
- Ezelion, E. (2004).Motivating Secondary Science Teachers to Face the Challenge of Third Millennium.*Journal of Nigeria 39(1 & 2) 1-18*
- Ezema, M.A, and Dung M.D (2003) *Concept of Mapping, STAN Integrated Science Education Series No, 2 NCCE, Abuja*.
- Federal Ministry of Education, (2007) *National Curriculum for Technical and Secondary Schools*. National Educational Research and Development Council (NERDC): Abuja,Nigeria.
- Federal Ministry of Education, (2013) *National Policy on Education*.Federal Government Press Lagos.
- Francis A. and Nathaniel L. (2002).Student Alternative Conception in Chemistry California.*American Journal of Science and Research 3(2) 56-69*.
- Francis, A. and Segun M. (2008).Student’s Teachers and School Environment Factor as Determinant of Performance in Secondary School Chemistry. *Journal of International Serial Research 1: (2) 10-24*.
- Gagne, R. (2008). *The Use of Simulators in R, Glazer (ED).Training, Research and Education*.Pillsbury University of Pillsbury Press.
- George, D. &Mallery, P. (2003).*SPSS for Windows Step by Step: A Simple Guide and Reference*. 11.0 Update (4th Ed.). Boston: Allyn & Bacon.
- Grabe, M. and Grabe, C. (as Certainedin Isa, 2012) *Integrating Technology for Meaningful Learning*. Boston: Houiton Muffin Co.
- Humphreys, H.B. and Imberted, C. (2012).*Models, Simulations and Representations*.London and New York.
- Ifeakor, A.C (2006). *The Status of Resources for Effective Teaching of Chemistry in Nigerian Secondary Schools*.4th Annual Conference Proceeding of Science Teachers Association of Nigeria (STAN) 173-177
- Ingalls, R.G. (2008). Introduction to Simulation.*Proceedings of the 2008 Winter Simulation Conference*(pp 17-26). Oklahoma State University,
- Isa, U. (2012). *Introduction to Science Education*.Stirlin-Horden: Publishers Nig. Ltd.
- James, T. (2000).*Effects of Combining Reflective writing with concept mapping and lecture method in the pre-science NCE, Teachers’ attitude and achievement in biology*. Unpublished Ph.D Dissertation, ABU, Zaria.

- Jeng-Fung H. and Jeng-Chin C. (2009). *The development of Simulation Modeling System and Modeling Ability Evaluation*. International Journal of U- and U- Services, Science and Technology. 2(4)1.
- Jengfung, H. and Lee-Chin, C. (2009). Simulation, Bringing the benefits of situated learning to traditional classroom. *Journal of Applied Educational Technology*, 3(1), 121-135.
- Johnson, D. W, Roger, T.J; and Smith A.S. (1991). *Active Learning Cooperation in the College Classroom*, Edina, MN Interaction Book Company.
- Lado, F.B. (2010) *The Effect of Teaching Methods, Gender and Academic Level on Pre-Service COE students Understanding of hybridization in Chemistry*, UnpublishedPGS thesis AbubakarTafawaBalewa University Bauchi.
- Laurilert, K. (2000). *Constructivism: Research and Essay*. Ablex.
- Laurillard, D. (2002) *Styles and Approaches in problem-Solving*. Harvard University Press.
- Loko J.S. (2005). *The Relationship between SSII Students' Performance and their Attitude in Science Practical in Makurdi Metropolis*. Unpublished M.ED Dissertation.
- Mahmood, A.A. (2009). *Study of Effects & Discovery and Lecture Method of Instruction on Academic Performance in Geniamong N.C.E Students*. Unpublished M.ED Thesis A.B.U Zaria. -
- Malgozta, B. (2006). Multimedia Software for representation of Chemical Reaction Mechanism – High School and College Level. *Journal of Educational Research*, 1(1), 11-35.
- Malgwuzenta, H.B. (2006). *Multimedia Software for Representation of Chemical Reaction Mechanism-High School College Level*.
- Mari, J.S. (2004). *How to Laboratory and Conduct Practical of Secondary School Students*. Being a Paper Presented at 2004 STAN Workshop Held in Kaduna 3rd - 4th June, 2004.
- Mari, J.S. (2009) *Gender Related Difference in Acquisition of formal Reasoning Chemata Pedagogic Implication of Teaching Chemistry*, Learning Process- Based Approach Presented at Departmental Seminar, Department of Education, Ahmadu 13th August 2009.
- Michael, L. (2007). *A Study of Teaching and Learning Acid and Base in Swedish Upper Secondary School*, Models in Chemistry Education. (1), pp. 15-36.
- Millar, R. (2004). *The Role of Practical Work in teaching and Learning of Science University of York*. Available at www.matimulacademicsorg/base Millar Draft Paper Jan 4 draft.

- Mockey, B. (2009). Teaching with Models: *National Science Digital with Library*: NSDI
<http://Sere Carleton Edul1086>: November, 2009.
- Nigerian Educational Research and Development Council National Policy on Education*
 Revised Abuja, NERDC, 2007 pp 2-3.
- Njoku, I.C. (2004). Effective use of Models for Science and Technology *Instruction*
Journal of Science Teachers Association of Nigeria, 39(1& 2), 43-50.
- Njoku, Z.C (2004) *Effective use of Model for Science and Technology*
Instructions. Journals of Science Teachers Association of Nigeria (STAN), 39
 (1&2) 45-51.
- Njoku, Z.C. (2007). Comparison of Student Performance in the Three Categories of
 Questions in SSCE Practical Chemistry Examination. *Journal of Science Teachers*
Association of Nigeria, 42(1& 2), 67-73.
- Nkwachukwu P.O. (2004). *Understanding Teacher Professional Competence for*
Educational Effectiveness WerairSpringfield Published Limited.
- Nwosu, A.A. (2004). Teachers' Awareness of Creativity Related Science Classroom.
Journal of Science Teachers Association of Nigeria 39 (1 & 2) 22-26.
- Obeka, S.S (2009) EPODEWALAD and Power Simulation Games of Geographical and
 Environmental Education. *A Journal of Science and Mathematics and Technology*
 1, 57-96.
- Ogbeba J.A. (2009). *Effects of Prior Knowledge of Instructional Objectives on Senior*
Secondary School Students Motivation and Performance in Biology Unpublished
 PhD Thesis, Faculty of Education Benue State University, Makurdi.
- Ohiu, M.H. (2005). A National Survey of Students Conception in Chemistry in
 Taiwan. *Chemical Education International*, 6(1), 211-216.
- Okafur, G.A. (2007). *Effects of Note Taking Patterns on Students Academic Performance,*
Interest, and Retention in Geography, Unpublished PhD Thesis, Department of
 Education, University of Nigeria.
- Okam, A.H. (2009). Problem-solving-model approach. *Education in Chemistry*, 27(6),
 163-165.
- Okebukala, P.A. (1996). Making Science Learner Friendly: Challenge for Science
 Teachers Association of Nigeria. *Newsletters*, 3(1), 211-216.
- Okebukola P.A. (2006). Students Performance in Practical. A case Study of some Related
 Factors. *Journal of Research in Science Teaching*, 24(2), 219-136.
- Okpala, L. (2006). Toward Effective Teaching of Music in Nigerian
 Schools. *International Journal of Research in Education*, 9(1), 1 57-1 63.

- Olurundare, H.S. (2012). *Best Practice in Teaching of Science in Secondary Schools in Nigeria*. Being a Paper Presented at Nigerian Educational Research and Development Council NERDC, and Capacity Building Workshop, Kwara State.
- Onekutu, A, Onekutu, P.O (2002) *Gender Differences In Performances in J.S.C.E in Integrated Science*. Implication for National Development in O.O. Okpeh. (Ed) Review of Gender Studies in Nigeria.
- Osunfur, A.M. (2001). *Effects of Fieldtrip and Role Play on Pupils Performance and Interest on Environment Concept in Primary Science*. Unpublished PhD Thesis, NSUKKA.
- Owu, G.O.M. and Randa, E. (2006).Some Aspect of Student Understanding of Representational Models of Particular Nature of Matter in Chemistry in Three Different Countries. *Chemistry Education Research and Practice* 7 (4), 226-236.
- Oyediran, A.M. (2004). *A Multi-media Approach to the Teaching of some Difficult Topics in Integrated Science Teaching*, 27 (5), 493-504.
- Papanastasiru, E.C. and Zembybs, M. (2004).Differential Effects of Science Attitude and Science Performance in Australia, Cyprus and the U.S.A. *International Journal of Science Education*,26, 259 -280.
- Papert, S. (2007) *Constructivism: Research and Essay, 1985-1990, Ablex*.
- Paul, H. (2012). The effect of simulation model on students' performance as well as the traditional lecture method in London.*Journal for Science Education*, 2(1), 23-31.
- Paul, H. and Cuyrille,L. (2012) *Models Simulations and Representation*.London and New York:Routledge ISBN 978-0-203-80841 -2 ebk
- Pavesic, B.J. (2008). Science Performance, Gender Differences and Experimental Work in Classes in Slovenia as Evident in TIMSS Studies.*Studies in Education Evaluation*, 34, 94-104.
- Raimi, S.M. (2002). *Problem Solving Techniques and Laboratory Skill as Implement to Laboratory Teaching in Senior Secondary School Students: Leaning of Volumetric Analysis*.Unpublished PhD Thesis University of Ibadan Nigeria.
- Reil, B. and Shab, L. (2007).The Role of Laboratory Work in University Chemistry *Journal of Chemistry Education Research Practice* 8, 172 — 185.
- Rudd, 1, Green Bowe, T.J. and Hand, E. (2002).Redrafting the General Chemistry Laboratory Report.*Journal of College Science Teaching* 31,230 - 234.
- Sam, O. (2011). *Mass Failure Worries Stakeholders, Sun Newspaper Retrieved May, 25,2011; from Intd/www.sunnewspaper.com/Ld*.
- Sambo, M.A. (2008). *Research Method in Education*.Stirlin-Horden: Publishers Nig. Ltd.

- Score, T. (2009). *Getting Practical a Framework for Practical Science in Schools*. London DCSF. Available at www.scoreeducation.org down loads Practical work framework.
- Seymour, R.D. (2008). A Model of the Technical Research Project. In Fisrael, & Wright (Eds), *Conducting Technical Research*. Mission Hills CA Calencoe Publishing Co.
- Seymour, R.D. (2008). A Model of the Technical Research Project. In F Israel and R.W right (Eds), *Conducting Technical Research* Mission Hills. CA, Glencoe Publishing Co.
- Shaibu A.A.M. (1987). *Problem-Solving Difficulties, Experienced by Nigerian Students of school of Basic Studies in Mechanistic Organic Chemistry* Unpublished Ph.D. thesis, University of Anglia, 1987.
- Stanoutasis, D. (2007). *Conceptual Understanding versus Algorithmic Problem Solving*. Further Evidence from a National Chemistry Examination Chemistry Research and Practice pp 15.
- Stephen, I. (2002). *Cognitive Style and Students Problem Solving Competence in Physics*. Unpublished Doctoral Thesis University of Uyo Pp 7.
- Tasdo, M. I (2002) A Study of Women Representation in Employment and Academic Enrolment. A Case Study of F.U.T. Minna. *Journal of Science and Sci., Tech, and Maths educ.* 1, 40-47
- Trowbridge, W. and Bylue, R. (1996). *Teaching Secondary School Science Strategies for Developing Scientific Literature*. New Jeracy: Merril Prentice Hall, pp 7-8.
- U.S. Department of Education (2001). *2000 Exemplary and Promising Science Programs*. Retrieved. Dec, 10 2007 in <http://www.ed.gov/office>.
- Udochukwu and Okasun (2009) *Unking Soap/Detergent Chemistry to Learners Day-today Activities*. Science Teachers Association of Nigeria (STAN) Chemistry Panel Series 4
- Usman, I.A. (2000). *The Relationship between Students Performance in Practical Activities and the Academic Performance in Integrated Science using NISTEP mode of Teaching*. Unpublished PhD Dissertation, A.B.U, Zaria.
- Usman, I.A. (2010). *The relationship between students' performance in practical activities and their academic achievement in Integrated Science using NISTEP Mode of Teaching*. Unpublished PhD Dissertatin, A.B.U, Zaria.
- Utulu, C.C. (1998). An Evaluation of Adequacy of Laboratory and Equipment in Secondary School in Edo State. *Journal of Education*, 32 (1& 2) 32-55
- Wakili, L.A. (2007). *The influence of Guided discovery approach on creative traits of integrated science students at Junior secondary school level*. Unpublished M.Ed Thesis, ABU, Zaria.

Winn, W and Snyder, D (1996) *Cognitive Perspectives in Psychology*. In Djonassen (Ed) *Handbook of Research on Educational Communication and Technology*. New York: Simon and Schuster. 7

APPENDIX A

Qualitative Analysis Performance Test(QAPT)

- Which of the following statements correctly explain why the formula of aluminium oxide is Al_2O_3 ?
 - The valence of aluminium is 3, that of oxygen is 2.
 - The valency of aluminium is 2, that of oxygen is 3.
 - The atomicity of aluminium is 2, that of oxygen is 3.
 - 2 molecules of aluminium combine with 3 molecules of oxygen.
- A mixture of ammonium chloride and potassium chloride can be separated by making use of the principle that:
 - One component is soluble in water and the other is insoluble.
 - One component sublime when heated and the other does not.
 - A bar magnet can attract one component.
 - The melting points of the components are different.
- The element with the atomic number 9 is likely to have chemical properties similar to an element with the atomic number.
 - 17
 - 10
 - 19
 - 11
- Which of the following laboratory instruments are used to separate mixture of two salts.
 - Volumetric flask, funnel and filter paper.
 - Beaker, stand and filter paper.
 - Stand, funnel and gas cylinder.
 - Flask, beaker and funnel.
- Solute reacts with solvent to form.
 - Solubility

- b. Solution
- c. Validity
- d. Liquidation

6. Solvent is often referred to.

- a. Solid
- b. Liquid
- c. Gas
- d. Steam

7. Cations are usually called.

- a. Basic radicals
- b. Acid radicals
- c. Salts
- d. Atomicity

8. Preliminary test in qualitative analysis often referred to.

- a. Physical properties
- b. Chemical properties
- c. Characteristics
- d. None of the above

9. Negative ions are usually referred to.

- a. Cations
- b. Anions
- c. Radicals
- d. None of the above

10. Racket is a laboratory apparatus which is normally used in.

- a. Quantitative analysis
- b. Qualitative analysis
- c. Both of them
- d. None of the above

11. Reagent for testing cations in the laboratory is.

- a. Hydroxide solution
- b. Acidic solution
- c. Solution
- d. Heterogeneous solution

12. Identification of basic radicals and acid radicals is called.

- a. Basic acid radicals
- b. Qualitative analysis
- c. Quantitative analysis
- d. Acid base titration

13. An element is electronegative if.

- a. It has a tendency to exist in gaseous form
- b. Its ions dissolve readily in water
- c. It has a tendency to gain electrons
- d. It readily forms covalent bonds

14. The property used in obtaining oxygen industrially from air is the.

- a. Density
- b. Solubility
- c. Boiling point
- d. Rate of diffusion

15. In which of the following is the oxidation state of oxygen different from its value in water?

- a. H_2O
- b. OH
- c. H_3O
- d. O^{2-}

16. The brown colouration in the nitric acid prepared in the laboratory can be removed by.

- a. Heating the acid
- b. Bubbling air through the acid
- c. Cooling the acid
- d. Adding a decolourizing agent

17. Tetraoxosulphate (vi) ions are usually tested using.

- a. Acidified BaCl_2
- b. Acidified AgNO_3
- c. Dilute HCL
- d. Acidified $\text{Pb}(\text{NO}_3)_2$

18. When NH_4Cl was dissolved in water the container was cold to touch. This implies that.

- a. The process is endothermic
- b. The process is exothermic
- c. NH_4Cl is highly soluble in water
- d. NH_4Cl forms a saturated solution

19. The gas which gives a pop sound when burnt is.

- a. CO_2
- b. H_2
- c. HCL
- d. NH_3

20. What is the IUPAC name of sulphuric acid?

- a. Tetraoxosulphate (vi) acid
- b. Hydrosulphate (vi) acid
- c. Hydrogensulphate (vi) acid
- d. Hydrogen tetraoxosulphate (vi) acid

21. What does an acid produce in the presence of water?

- a. Salt
- b. Oxygen
- c. Effervescence
- d. Hydroxonium ion

22. Which pH values indicate an acid solution?

- a. 3
- b. 7
- c. 9
- d. 14

23. When the salt is completely dissolved in water is often referred to.

- a. Sublime
- b. Submit
- c. Substitute
- d. Solubility

24. We use to test the salt solution either is acidic or alkaline.

- a. Paper
- b. Litmus paper
- c. Red paper
- d. None of the above

25. Filtrate and residue are obtainable through the process of.

- a. Distillation
- b. Sublimation
- c. Filtration
- d. Chromatography

26. Which metal will dissolve in aqueous sodium hydroxide?
- Aluminum
 - Copper
 - Iron
 - Silver
27. The minimum amount of energy required from a chemical reaction to occur is known as.
- Activation energy
 - Bond energy
 - Energy formation
 - Energy of reaction
28. The green colour solution of an Fe^{+2} salt changes to brown solution of an Fe^{+3} salt by.
- Conversion
 - Elimination
 - Oxidation
 - Reduction
29. Which of the following is NOT separation techniques?
- Crystallization
 - Distillation
 - Evaporation
 - Hydration
30. The best treatment for a student who accidentally poured concentrated tetraoxosulphate (vi) acid on his skin in the laboratory is to wash the skin with...
- Sodium hydroxide solution
 - Sodium chloride solution
 - Cold water
 - Iodine solution

APPENDIX B
Marking Scheme for QAPT

1. a	16. d
2. b	17. a
3. a	18. a
4. a	19. b
5. b	20. a
6. b	21. d
7. a	22. a
8. a	23. d
9. b	24. b
10. b	25. c
11. a	26. a
12. b	27. a
13. c	28. a
14. d	29. d
15. d	30. a

APPENDIX C

Students' Attitude towards Qualitative Analysis Concepts Questionnaire (SAQACQ)

Dear respondent, below are questions meant to measure your opinion on your attitude towards the questions in simulation of qualitative analysis. I will appreciate your contribution in filling the questionnaire objectively. It consists of section A and B; you are to respond to both sections. Please kindly give your response correctly.

Thanks;

Section (A) Respondent's Bio-data

Student's Number

School:

Sex:

Male

Female

SECTION (B) please tick appropriate column using the following keys:- SA=Strong(y agree, A= Agree, U= undecided, D= disagree SD=strongly disagree respectively.

S/N	Items	SA	A	U	D	SD
1	I like qualitative analysis because it does not involve calculation					
2	Poor performance by others in practical chemistry makes me dislike it					
3	I fear coming contact with chemicals during practical					
4	Chemistry is hazardous that is why I hate it					
5	Practical chemistry is enough to make me self-reliant					
6	Practical chemistry is easy to me					
7	Recognition of colour change(s) when mixing chemical during practical chemistry is my problem					
8	I don't think I will need chemistry for my future. Because my teacher had never allowed me to handle apparatus myself during practical, always he is the one doing everything for us.					
9.	I cannot recognize any gas during qualitative analysis because they all smell almost the same					
10	If chemistry teachers use local materials in practical's, I would have study it further					
11	Balancing chemical equation is interesting in practical chemistry					
12	I hate chemistry practical's because there are more failures in it than passes					
13	I feel extremely frightening to practical examination in					

	chemistry					
14	Chemistry practical in volumetric analysis is not interested					
15	Qualitative analysis is a diffluent task in practical chemistry a. agree b. disagree c. strongly agree					
16	Students are not exposed to cations and anions identification until it is time to write their mock examination/SSCE a. agree b. disagree c. strongly agree					
17	Generally, students are not conducting practical as it is scheduled to take place in their syllabus. a. agree b. disagree c. strongly agree					
18	Majority of the students do not attend their lessons regularly. a. agree b. disagree c. strongly agree					
19	Some chemistry teachers are not professional teachers a. agree b. disagree c. strongly agree					
20	Principal who is not science oriented does not encourage chemistry teachers to carryout practical at school. a. agree b. disagree c. strongly agree					
21	Substandard chemistry laboratory discourage chemistry teachers to conduct practical. a. agree b. disagree c. strongly agree					
22	Outdated chemistry teachers in-services in having practical. a. agree b. disagree c. strongly agree					

APPENDIX D

Difficulty Index and Discrimination Index

Item	Difficulty Index	Discrimination Index
1	48	0.45
2	46	0.45
3	29	0.42
4	25	0.48
5	49	0.53
6	30	0.27
7	50	0.45
8	53	0.45
9	55	0.42
10	41	0.50
11	47	0.47
12	35	0.51
13	43	0.49
14	45	0.55
15	65	0.52
16	42	0.58
17	48	0.60
18	46	0.47
19	29	0.56
20	25	0.53
21	49	0.51
22	30	0.48
23	50	0.50
24	53	0.50
25	55	0.50
26	41	0.44
27	47	0.43
28	50	0.45
29	48	0.45
30	44	0.42

Appendix E

Lesson Plan for Experimental Group (Simulation Method)

Week 1

Subject:	Chemistry
Topic:	Qualitative analysis
Class:	SSII
Duration:	40 Min
Behavioral Objective	At the end of the lesson, students should be able to <ol style="list-style-type: none">1. Define qualitative analysis2. Mention components of a substance (compound)
Provisions Knowledge	Students have been taught ionization process
Presentation of the lesson	<ol style="list-style-type: none">1. The teacher introduces the lesson, by asking the student to state the definition of ionization.2. The teacher states the definition of qualitative analysis thus: qualitative analysis is defined as the identification of cations and anions in a given salt solution.
Problems to solve	(3-5) Minutes) Write the ionization process of the substances (compound) using equations only Sodium chloride, calcium carbonate and potassium fluoride
Solution	Step 1 sodium + Chlorine \longrightarrow Sodium chloride Step 2 $\text{Na}_s + \text{Cl}_g \longrightarrow \text{NaCl}_s$ where s= Solid g= gas Step3 Ionization process $\text{Na} \longrightarrow \text{Na}^+ + e^-$ where e^- electron Sodium lost one electron and become sodium ion (Na^+)



Chlorine gains an electron and becomes a chloride ion (Cl^-)



Positive Negative neutral

$$+1 - 1 = 0$$

When a compound is formed, it becomes neutral because the charges cancel each other.

1. Note the sodium ion (Na^+) and chloride ion (Cl^-) are the real components of sodium chloride compound.
2. So the above expression is what is called mental simulation.
3. The teacher states terminologies of qualitative analysis.

These terminologies

1. Basic radical is what is called cation or positive ion.
2. Acid radical refers to anion or negative ion.

Evaluation of the lesson

1. Define qualitative analysis.
2. Mention any three (3) chemical compounds and their real components.

Summary and conclusion

Highlight the main points of the lesson with the students.

Week 2

Class:	SSII
Topic	Solubility of the salt
Duration	1 hour 20 minutes
Materials:	Diagram, the salt, water, test-tube, rasket and litmus paper
Behavioral objectives of the lesson:	At the lesson, students should be able to: 1. Explain the solubility of the salt 2. Mention the action of the litmus paper
Previous knowledge	Students have been taught about definition of qualitativew analysis and real components of a substance.
Presentation of the lesson	<ol style="list-style-type: none">1. The teacher introduces the lesson, by asking the students to mention some chemical compounds and their real components.2. The teacher explains what solubility is. Solubility is reffered to when the salt is completely dissovled or disappeared in th solvent (H₂O). Now use the mathematical simulation model to write the chemical equation of the solubility process. The mathematical simulation model of the solubility process is given as Solute + solvent = solution $\text{CaSO}_{4(s)} + \text{H}_2\text{O}_{(l)} = \text{CaSO}_{4(aq)}$Where S = Solid, L= liquid, aq = aqueous3. The teacher explains preliminary test. Therefore preliminary test is the physical properties of the salt solution. This incldue colour, smell (odour) and texture4. The teacher will demonstrate how to carry out solubility accurately. Now take the following precautions into consideration first.<ol style="list-style-type: none">i. Get a clean, dry test –tube, using spatula. Do not put much salt or use dirtry test-tube or using free hand toi put the salt into a test –tube. These can lead to poor solubility of the salt.ii. Add about 2cm³ or 3cm³ of H₂O into clean, dry test-tube containing dry salt using meansuring cylinder. Do not take 6cm³ of the water, this will lead to poor solubility.

Students Activity	<p>Form a group of five (5) that is five (5) per group and carry out solubility porcess by using the salt given to you and observe</p> <ol style="list-style-type: none"> any visible change occur the action of litmus paper
Evaluation of the lesson	<p>The teacher evaluate the lesson,by asking the students to:</p> <ol style="list-style-type: none"> State what solubility is? Give the action of litmus papert in the salt solution Write the mathematical simulation model of the solubility.
Summary and Conclusion	<p>Highlight the main points of the lesson with the students.</p>

Week 3

Class:	SSII
Total	Filtration process
Time	40 minutes
Materials:	Disgram funnel, filter paper tes- tubes and racket
Behavioural Objectives of the lesson: Lesson	At the lesson, students should be able to: 1. Explain filtration process 2. List the materials use tocarry out filtration
Previous knowledge:	Students have been taught solubility of the salt and preliminary test.
Presentation of the lesson	1. The teacher intorduces the lesson, by asking th student to solubility and preliminary test. 2. The teacher explains what filtration is Filtration is a physcial process of seperating mixture of soulute and solvent. Materiasl that are used in fitration filter paper funuel and racket.
Note:	What passed through th filter paper is called filtrate and what remain on the filter paper is residue
Students Activity	Use the following and carry out filtration. Salt, water, filter paper, test-tubes, funnel racket and spatula and detemrine filtrate and residue.
Evaluation of the lesson	1. What is filtration?

2. State reason why filter paper is used in filtration not an ordinary paper.

Summary and conclusion

Highlight the main points of the lesson, with the students.

Week 4

Class:	SS II
Topic	Experiment test
Time	1hr 20 minutes
Materials	Diagram of qualitative analysis simulation process, NaOH solution, test –tube, AgNO ₃ and racket
Behavioral objectives of the lesson	At the end of the lesson, students should be able to <ol style="list-style-type: none">1. Explain the steps involve inqualitative analysis concepts using qualitavie analysis simulation proces.2. Carry out tests and write good obserevation and logical inferenece
Previous knowledge	Students have been taught filtration process.
Presentation of the lesson	<ol style="list-style-type: none">1. The teacher introduces the lesson, asking the students to mention the end – products of th filtration process.2. The teacher expalins steps involve in qualitative anlayiss conepts using qualitative analysis simulation process. <p>Problems 1 to solve (5-10 mins)</p> <p>Carry out filtration using filter paper, and funnel and determine</p> <ol style="list-style-type: none">a. Filtrateb. Residuec. Test the filtrate with litmus paper <p>Problems 2 to solve (10 – 15 minutes)</p> <ol style="list-style-type: none">1. To about 2cm³ of the filtrate, add NaOH in drop

then in excess

2. To the resulting mixture, add dil. HNO_3 followed by a few drops of AgNO_3
3. Put half of the residue into a test –tube and add HNO_3 warm the mixture
4. To about 2cm^3 of clear solution from (3) above, add HN_3 in drops and then in excess.

Record your observation from each test. State a logical conclusion of each test.

Evaluation of the Lesson

1. Outline the simulation process of qualitative analysis by using appropriate model chart.
2. Use mathematical simulation model and write the correct chemical symbol and their correct charges of cations and anions obtain from the observation made from the test.

Summary of the lesson

Summarize the key points to take into consideration

1. Chemical reagents like NaOH NH_4OH use for testing cations in the salt solution, silver nitrate solution (AgNO_3) use to test anion like chloride ion (Cl^-).

Conclusion of the lesson

A sample of WAEC Question of 2014 May/June will be administered to the students and carry out the experiment.

APPENDIX F

Lesson Plan for Control Group

Week I

Class:	SSII
Subject:	Chemistry
Topic:	Definition and terminologies in qualitative analysis
Time:	40 minutes
Materials	Chemical reagents, litmus paper, salt, test tubes, funnel, filter paper, water and racket expose to student
Behavioural objectives of the lesson:	At the lesson, students should be able to: 1. Define qualitative analysis concept. 2. Give some explanation on some important terminologies in qualitative analysis concept
Previous knowledge	Students are aware of concept of dissociation of compounds.
Presentation of the lesson	1. The teacher introduces the lesson, by asking the students to explain concept of dissociation of compounds. 2. The teacher defines qualitative analysis concept 3. The teacher mentions or list some terminologies in qualitative analysis concept 4. the teacher explains the listed terminologies one by one by citing relevant examples
Evaluation of the lesson	1. Define qualitative analysis concepts 2. Mention two terminologies qualitative analysis Assignment use only equation to explain the following compounds 1. CaSO_4 2. NaCl 3. ZnCO_3
Blackboard Summary:	Qualitative analysis is defined as the identification of cations and anions in a given salt solutions are called cations or positive ions while acid radicals refers to anions or negative ions.

Week 2

Class:	SSII
Topic:	Solubility process and precaution
Time:	40 minutes
Material:	Salt, water, and test-tube.
Behavioral objectives of the lesson	At the lesson, students should be able to <ol style="list-style-type: none">Explain what solubility isMention three precautions of solubility process.
Previous knowledge	Students have been taught terms used in qualitative analysis.
Presentation of the lesson	<ol style="list-style-type: none">The teacher introduces the lesson by asking the students to mention some terms used in qualitative analysis concept.The teacher explain what solubility isThe teacher mentions some precautions of the solubility process.
Evaluation of the lesson	The teacher evaluates the lesson, by asking the students to: <ol style="list-style-type: none">Define solubilityState 3 or 4 precautions of the solubility process.
Blackboard Summary	Solubility is referred to when the salt is completely dissolved or disappeared in the solvent (water) Solute + solvent = salt solution Salt + water = Salt solution precautions of the

solubility process are as follows:

1. use clean dry test-tube not moist one or dirty one
2. use small quantity of the salt not large quantity
3. Use spatula to put salt into a test –Tube not contain the salt. Do not use 10cm^3 of water to dissolve the salt.

Week 3

Class	SSII
Topic:	Filtration and action of litmus paper
Materials	Salt, water, filter paper funnel racket and test-tubes
Behavioral objectives of the lesson:	At the lesson, students should be able to <ol style="list-style-type: none">1. State the definition of filtration process.2. Distinguish between filtrate and residue3. Mention the action of litmus paper.
Assignment	State the reason why filter paper is used in the filtration not an ordinary paper.
Blackboard Summary	Filtration is a physical technique of separating two mixtures of solute and solvent. Filtrate is a clear solution collected in a clean test –tube after filtration while residue is what remains on the filter paper after filtration process. Litmus paper is used to test either acidity nature or alkalinity of a solution.

Week 4

Class: SSII

Topic: Experimental theory of qualitative analysis

Time: 1hr 20 minutes

Materials: Pen: and paper

Behavioural objectives of the lesson: At the lesson, students should be able to:

1. Draw the tabulation form of qualitative analysis
2. Complete (1) above with the relevant information

Previous knowledge: Students have been taught filtration

Presentation of the lesson: 1. The teacher introduces the lesson, by asking the students to define filtration process and state the end products of the filtrations.

Blackboard Summary: Tabulation form of qualitative analysis

a. C + water

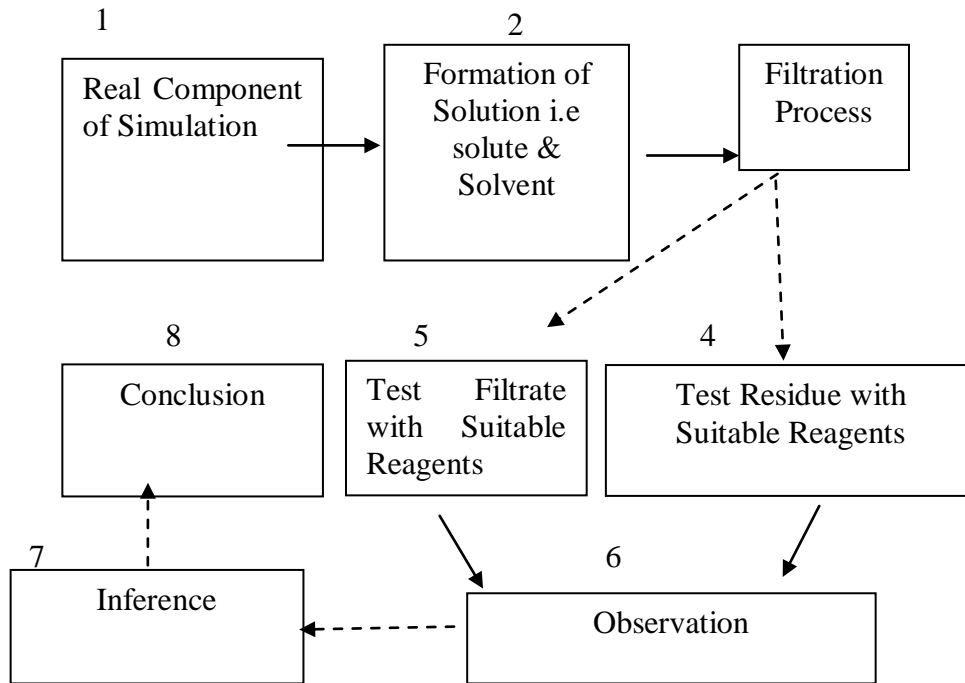
	Test	Observation	Inference
a.	C + Water	Colourless odourless	
b.	Filtrate + lit	Colorless, odourless solution turns blue litmus paper red	It is alkatine solution
c.	Filtrate + NaOH _(aq)	While ppt is formed in soluble in NaOH but soluble in excess	Zn ²⁺ Present
	Test	Observation	Inference
a.	C + H ₂ O +		

Evaluation of the lesson copy and complete the table below

	filter		
b.	Filtrate + Litmus Paper		
c.	Filtrate + NaOH _{aq} + heat		
d.	Residue + Few dropsof NH ₃ solution		

APPENDIX H

THE SIMULATION PROCESS



Source: (Adapted from Obeka, 2009)