EFFECTS OF MASTERY LEARNING STRATEGY ON SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS' MOTIVATION AND ACADEMIC PERFORMANCE IN KARAYE EDUCATION ZONE KANO, NIGERIA

BY

Isyaku Zarewa BALA
B.Sc. (Ed) Chemistry (ABU, 2013)
P14 EDSC 8001

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA, NIGERIA. IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS DEGREE IN SCIENCE EDUCATION

DEPARTMENT OF SCIENCE EDUCATION
FACULTY OF EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA

APRIL, 2018

DECLARATION

I hereby declare that this dissertation entitled "EFFECTS OF MASTERY LEARNING STRATEGY ON SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS MOTIVATION AND ACADEMIC PERFORMANCE IN KARAYE EDUCATION, ZONE KANO, NIGERIA" has been written by me, in the Department of Science Education. It is a record of my own work and it has not been presented in any previous application for a higher degree. All quotations and sources of information are fully acknowledged by means of references.

BALA Isyaku Zarewa	………………………	…………………
Student's Name	Signature	Date

CERTIFICATION

This dissertation entitled "Effects of Mastery Learning Strategy on Senior Secondary School Chemistry Students Motivation and Academic Performance in Karaye Education, Zone Kano, Nigeria" by Isyaku Zarewa BALA P14EDSC8001 meets the regulation governing the award of Masters degree in Science Education of Ahmadu Bello University Zaria, Nigeria and is approved for its contribution to knowledge and literary presentation.

…………………………………… …………………………
Prof. J. S. Mari Date
Chairman Supervisory Committee

…………………………………… …………………………
Dr. S. B. Olorukooba Date
Member Supervisory Committee

…………………………………… …………………………
Prof. S.S. Bichi Date
Head of Department

…………………………………… …………………………
Prof. A. Z. Mohammed Date
Dean, School of Post Graduate Studies

DEDICATION

This dissertation is dedicated to my late father Malam Bala Isyaku and his wife late Salamatu Idris, my wife Khadija Suleiman and my children Aishatu, Usman (Amir), Habiba and Rahmatu. May God bless you all.

ACKNOWLEDGEMENT

All praise is due to Allah who designed and ordered my steps and sustains me throughout this programme.

I appreciate Kano State Senior Secondary Schools Management Board (KSSSMB) who single handedly sponsored this study, granted me the permission to be away from home and further my studies.

A special thanks go to my enthusiastic, the tireless and ever encouraging efforts of my first supervisor – Prof. J. S. Mari and my second supervisor Dr. S. B. Olorukooba who were with me both during and after office hours, not only for their tremendous academic support, but also for giving me a wonderful opportunities that has been delighted and I have gained a deeper educational experience as a result of working with them. A truly dedicatedmentors, for me for two years. May the God shower such kindness to your families.

I wish to express my sincere gratitude to the Head of Department in person of Prof. M. Musa and to all my lecturers in Science Education Department such as Prof. (Alh.) I.A. Usman, Prof. S. S. Bichi, Dr. (Mrs) B. Abdulkarim, Dr. M. O. Ibrahim, Dr. F. K. Lawal, Dr. T. E, Lawal., Dr. M.K. Falalu, Prof. M. A. A. Shaibu, Prof. M. A. Lakpini,Dr. S.S. Obeka among others. For imparting me with knowledge words of encouragement and moral support which added the quality to this research work.

My regards to special people who were instrumental to the success of this study like Dr. A. B. Muhammad, Dr. M. I. Harbau, Prof. M. M. Atadoga, Prof. S. Sambo, Prof. M. Balarabe for their words of advice and encouragement.

Similar profound gratitude go to Sunusi Bala Zarewa, Alh Sunusi Bala, Nasiru Shitu Getso, Mr. Adamu Luka and Nasiru Tanko, not only for their tremendous educational support, but also giving me a wonderful opportunities and financial support. I am also very appreciative to Dr. U.A,Ginga who has helped me with everything about quantitative statistics and helped me tremendously with my dissertation design.

I also appreciate the inspiration and cooperation given by my friends Amos K. Labesa, Ahmad Shehu, Hafiz Sale, Musa Abdu and my lovely sisters Zainab Abduallhi, Halima Salisu and Jummai Salihu Ramatu

My acknowledgement will not be complete without mentioning my uncle Alh. Kabiru Ahmad Zarewa, Yahaya Hassan, Ado Ahmad, Rabiu Abdu, Usman Abdullahi, for encouraging me on my MEd path and inspiring me in many ways academically, and Mr. Abdullahi.(Baban Amir) who co-typed this work with me.

Finally, I wish to express my sincere gratitude to my family and dear friends. I want to thank my parents and my sisters for their love, patience and support throughout my quest to obtain Masters Degree. I sincerely thank all other people too numerous to mention who have made one input or another in this study. God bless and appreciate you all.

ABSTRACT

The study investigated the Effects of Mastery Learning Strategy on Senior Secondary School Chemistry Students Motivation and Academic Performance in Karaye Education Zone, Kano State, Nigeria. The design of the study was quasi experimental, the pretest, posttest design. The population of the study comparised of 3,590 SSII chemistry students out of which, a sample of One Hundred and Sixty One (161) chemistry students from four single sex schools were used for the study, the sample was categorised into two groups; the experimental group consisting of (89) students and control group consisting of(72) students. A pretest was administered before the treatment to establish group similarity in their ability. The sample in the experimental group, were exposed to mastery learning strategy instruction for a periods of six weeks. Four (4) research questions and four null hypotheses guided the conduct of this study. The instruments used for data collection were Chemistry Student Performance Test (CSPT) and Student Motivation Questionnaire (SMQ) with reliability coefficient r = 0.73 and 0.76 respectively. Mean and standard deviations were used to answer research questions while t-test and Mann-Whitney statistics were used to test the hypotheses at $p \leq 0.05$ using Statistical Package for Social Sciences (SPSS) and Microsoft excel computer.The results shows that mastery learning is effective in enhancing students performance and motivation in chemistry.From these findings the recommendation made, among others, was that chemistry teachers should be encouraged to adopt mastery learning instructional strategy in teaching chemistry concepts, in order to enhance chemistry students academic performance and motivation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

APP: Advance Placement Programme

CSPT: Chemistry Student Performance Test

FISS: First Intenational Science Study

FME: Federal Ministry of Education

LFM: Learning For Mastery

MLA: Mastery Learning Approach

NECO: National Examination Council

NERDC: Nigeria Educational Research and Development Council

PSI: Personalise System of Instruction

SISS: Second International Science Study

SQM: Student Motivation Questionnaire

SSCE : Senior Secondary School Certificate Examination

SSII: Senior Secondary School Two

STAN: Science Teachers Association of Nigeria

STP: Standard Tempreture and Pressure

TIMSS: Third International and Mathematics Science Study

WAEC: West African Examination Council.

OPERATIONAL DEFINITION OF TERMS

Extrinsic Motivation: Refers to behaviors that are driven by external rewards such as grades and praise, money and fame etc.

Intrinsic Motivation: Refers to behavior that is driven by internal rewards.Examples: joy, happiness, e.t.c.

Mastery Learning Strategy: An instructional strategy using the sequencing of materials to be learnt into units and subunits with well define behavioural objectives which would be achieved at the end of every unit with feedback.

Motivation: Internal and external factors that stimulate desire and energy in people to be continually interested and committed to a job, role or subsect or to move an effort to attain a goal.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Chemistry has become one of the most important disciplines in the school curriculum; its importance in the general education has gained world-wide recognition. Chemistry as a branch of science is a rational and mathematical discipline where certain measured and controlled inputs lead to certain predictable outputs (Learning Things 2014). The role of chemistry in our daily and national life as well as in the industry is undaunted. Many of our day-to-day activities revolve around chemistry. The benefit of learning and advancing in science and technology can be extrinsic and intrinsic, and such has been identified with chemistry. Teaching and learning of science have significant roles towards technological development in a developing nation since chemistry is embedded in our life and society, economical, ecological and societal influences (Hofstein& Bybee, 2011).

Efforts made through research to discover the causes of the persistent failure in chemistry revealed among others, that secondary school chemistry teachers mainly adopt the lecture method and lack of motivation in the teaching and learning of chemistry(Udoh,2008). Lovat(2003), observed that “teaching is not an incidental craft to follow naturally from mastery of subject content, but a highly complex blend of theoretical understanding and practical skill”.Mastering of chemistry concept by students enhance them to a meaningful learning, Meaningful learning occurs when learners comprehend chemistry concepts and are able to connect them with priorknowledge (Ausubel, 2000 &Omolade, 2008).

When students learn chemistry meaningfully, their ability to reflect on their own learning and make adjustments accordingly fosters deeper learning. Deeper learning is the key strategy through which students find meaning and understanding from course material and experiences (Warburton, 2003). This in turn may result to competence of knowledge transfer to other domains and how to apply the knowledge in answering questions and resolving problems (Pellegrine & Hilton2012).

However, record of analysis of students' results in senior secondary school Chemistry and other science subjects such as Physics and Biology for a number of years has revealed dismal failure, with Chemistry being the least (WAEC Chief Examiner's Report, 2014).Research has shown that students do not enter the classroom as a "blank state" (Pinker, 2003). Learners construct knowledge by making connections between new information and their existing conceptual network. Efe,(2015) noted that "learning is an active process of knowledge construction, the making of connections between existing network of knowledge". According to Bybee (2009), students' prior conceptions, ideas and experiences which they carry to the classroom influence the way they learn new concepts and skills. Hence, it is important that they are actively engaged in the learning process and that they are challenged to reflect on their own learning besides being able to link their prior knowledge to new knowledge.

In Nigeria recent studies done (Eze,2002: Egbo,2005;Ameh & Dantani,2012; Opara & Waswa,2013 & Muhammad,2014), suggest that teachers are in a hurry and tend to rush through the scheme of work to enable them cover the topics in the curriculum within the given period without proper mastery of the topics covered.Feedback on students learning outcome in Senior Secondary School chemistry in Nigeria is not encouraging. Students' Performance in Senior Secondary School Certificate Examination in Chemistry from 2010 to 2015, shows that the students who sat for the examination within this period could not attain a credit level.

Studies have shown that a number of factors are responsible for this. However, most of the emphasis is on the teacher, his teaching methods, motivation and materials. Studies on underachievement of students in secondary school subjects found inefficientteaching methods by school teachers as a major factor for the underachievement of students, (Pepple, 2010, Usman & Memeh, 2007, Nwagbo, 2001,). Table 1.1 below indicates the students' performance in senior secondary school examination result from 2010-2015.

Table 1.1: WAEC May/June ChemistryResults from 2010-2015 in Nigeria

Year	No. Of Candidate That Sat For WAEC	No. of Candidate Sat for Chemistry	% of Pass in Chemistry	% of Failure in Chemistry
2010	1,351,557	31,102	13.93	86.07
2011	1,540,250	128,034	6.43	93.57
2012	1,529,425	659,132	31.18	68.82
2013	1,308,217	86,612	29.17	70.83
2014	1,692,435	791,227	31.28	68.72
2015,	1,605,248	758,849	38.68	61.32

Source: From WAEC Result, January, (2015)

According to Herrera (2001), to improve the performance of learners in chemistry, the role of the teacher becomes crucial in the teaching and learning process. The teachers should not only teach content knowledge of chemistry but should be able to initiate strategies that are required by the content to make learning meaningful, integrated and transferable. With this deplorable state of chemistry, mastery learning strategy is the solution, and that is what interested the researcher to investigate the effect of mastery learning strategy.

The West African Examination Council Chief Examiner's Report (2014) indicated poor method of teaching, motivation and lack of mathematical skills are some of the major reasons for the poor performance of students in chemistry. This agrees with Krammer (2005), who found that students without motivation, poor mathematics knowledge and use of inappropriate method of teaching could not master some chemistry concepts.

However, the method a teacher adopts in teaching, lack of motivation and poor mathematical skills of the students are some of the major reasons for the poor performance of students in chemistry, Bloom (1968) developed an instructional-strategy that could help students to overcome learning difficulties. Bloom's theory of school learning asserts that virtually all students can learn what they are taught (that is 'A' standard), if given the appropriate and prior conditions. Bloom, argued that if students were normally distributed with respect to aptitude and are given uniform opportunity to learn and quality of instruction, only few students would achieve mastery in their learning since the aptitude of each student will determine the degree of learning. Based on this, Bloom (1968) developed a mastery learning model called Learning ForMastery,(LFM).

Bloom's learning for mastery was derived from Carroll's, group-based mastery learning model which was only conceptual and theoretical. Bloom expanded and transformed Carroll's model into an instructional and practical system for classroom learning in 1968. Mastery learning is a theory that suggests that virtually all students can attain a high degree of learning if given the needed time and appropriate learning conditions and that if teachers could provide these appropriate conditions, virtually all students could reach a high level of achievement and the differences in their levels of achievement would vanish (Georgina, & Lessi 2015). Bloom, 1974 in (Georgina, et al. 2015), stated that the precondition to the development of mastery learning is to define what mastery is, specify the objectives and content of instruction and to set the criteria accepted as mastery so that the teacher will be able to know if a student has attained mastery of concept taught or not. Therefore, there is a need for a change in the teaching and learning of chemistry concepts among students in schools.

Mastery learning strategy is an instructional method of teaching, using the sequencing of materials to be learnt into units and sub-units with well defined behavioural objectives which would be achieved at the end of every unit with test to measure the performance of the students. Sliva (2003)defined mastery learning as teaching a skill to the level of automaticity, ability to deduce the general from particular case to form a concept. Therefore, the researcher has decided to investigate the effect of mastery learning strategy on senior secondary school students in chemistry performance.

The mastery learning strategy places considerable emphasis upon the selection of the objectives, because objectives determine the success or failure of a learning programme based on the amount of instructional time. Similarly (Joyce 2006), found that relevant learning was greater when students were provided with objectives prior to the beginning of the instruction. Objective must be defined in behavioural and measurable terms so that success of the programme may be assessed exactly and accurately objectives are presented as specific statements of the goals or outcome that the students are expected to reach.

Mastery learning instructional strategy defines the specific skills, the key concepts the basic ideas and the specific facts that the students must learn in order to complete the programme successfully. The performance level is called mastery level or minimum pass level. The level of performance expected from the students at the end of each instructional unit must be defined very clearly. The minimum pass level which may be considered reasonable for each learner should not be less than 70% before moving to another level.

The material the students are to learn over a period of time should be divided into smaller units and criteria for performance should be established, then formative tests should be administered during the teaching of each unit of learning. The results of the formative tests should provide feedback to the teacher and the students. This will enable the teacher to find out the students that have gained mastery and the ones that have not, and to enable the students to know the aspects they are not doing well and will need to improve upon. This is done by checking the performance from the formative tests against the set criterion accepted as mastery level. The students that have attained mastery are commended and could be used as peer tutors. The students that did not gain mastery are given corrective instruction based on the identified areas of difficulties from the results of the formative test and the test is administered to them again. The corrective instruction could be done through reteaching, peer tutoring, homework, small group discussion, and so on. This process continues until virtually all the students master the taught material before the teacher moves to the next unit of learning. Bloom argued that if students are taught with this form of teaching virtually all of them will attain a high degree of learning.

Mastery learning instructional strategy is an instructional strategy where students are allowed unlimited opportunities to demonstrate mastery of content taught, Kibler, Cegalda, Walson, Barther & Miler in Wambugu and Changeiywu (2008). Mastery learning instructional strategybreakdown the subject matter to be learned into units of learning, each with its own objectives.Adepoju (2001) refers to mastery learning as an innovation which in its various form is designed towards making learners to perform beautifully well in an academic task. Also Adeyemi (2007) described mastery learning as a teaching strategy that involves a pre-specific criterion level of performance which students must master in order to complete the instruction and move on. According to him, mastery learning involves frequent assessment of students' progress; it provides corrective instruction and emphasizes on all participation, feedback and reinforcement.

In the same vein, Wambugu and Changeiywo (2007) opined that mastery learning help the students to acquire prerequisite skills to move to the next unit. Mastery of each unit is shown when the students assure the set of pass mark of a diagnostic test. The teacher is also required to do task analysis and state the objectives before designing the activities. Mastery learning instructionalstrategy can help the teacher to know students area of weakness and correct it, thus breaking the cycle of failure. Result from research studies carried out on mastery learning strategy suggest that the method yields better motivation, retention and transfer of materials, yield greater interest and more positive attitude in various subject than non-mastery learning strategies (Ngesa, 2002, Wachanga& Gamba, 2004 & Wambugu & Changeiywo, 2007). The teaching method a teacher adopt is a strong factor that affect the students motivation towards learning, therefore affecting achievement.

Motivation is a theoretical construct used to explain behavior. It presents the reasons for people's actions, desires and needs. Motivation can also be defined as one's direction to behavior and vice versa,(Deci & Ryan 2009).However mastery instructional-strategy enhances students' motivation for science learning, both in terms of intrinsic motivation (relevance, meaningfulness, as assessed by the students) and extrinsic motivation (teacher encouragement and reinforcement) and attempts to make school science content more meaningful (Devetak Vogric & Glazer, Bolte, Streller, 2011, Bolte & Holbrook, 2011). The mastery learning instructional-strategy focus on students motivation to learn science as there is a strong research evidence that influences cognitive and metacognitive processes amongst students and thus stimulates higher forms of thinking and determines the individual's attitude and approach to learning and to activities that lead to (creative) learning achievements (Deci & Ryan, 2009; Rheinberg, Vollmeyer & Rollett 2000,; Jurisevic, Devetek & Vogric 2012; Schunk & Zimmerman 2008).

Moreover, from this point of view the masterylearning instructionalstrategy enhances both extrinsic motivational orientation (example; extrinsic rewards most by means of teacher' motivational feedback) as well as intrinsic motivational orientation (example; interest in science, meaningfulness of learning, academic self-concept) are important, but the later is highlighted (Devetak et al 2011; Bolt. & Holbrook,2011) Motivation to learn develops in the process of differentiation during the student's learning development, from the very beginning of the educational process and it's a part of the wider student's life and is contextually dependent(Schunk & Zimmerman 2008; Jurisevic et al 2012). It is good to determine methods for their capacity to enhance inspiration self-efficacy and motivation for active participation in learning. Motivation enhances concrete learning as well as mastery of learning context which help students to gradually develop their own social-participatory learning role depending on their own perception of individual features of the existing learning context.

In addition, mastery instructional strategy helps in raising students' motivation in science learning and the development of science competences. Science competences comprising the in-depth understanding of science concepts, being able to conduct research, understanding nature of science and being able to analyse and evaluate information from everyday live science and so on (Deci & Ryan 2000). Development of competency and knowledge of learning materials inspires and motivate learners and also build their self-efficacy and capacity to seek further knowledge and experience in such areas. As mastery learning enhances competence and meaningful learning, participants are expected to acquire deep inspiration and motivation to actively engage in learning.This is because researchers show thatmotivated learner performs well (Hancock 2004).

The teaching approach a teacher adopts is a strong factor that may affect the students' motivation towards learning, therefore affecting the achievement. Motivation can be enhanced through mastery learning-instructional strategy that actively involves students (Keraro, Wachanga & Orora, 2005). Students are categorized as academically motivated when they are able to maintain a high ability and are competent in their work. How the teachers view motivation will influence what they should do to establish a classroom environment that will enhance students' motivation (Wambugu et al, 2007). A teacher has the ability to influence the students' motivation to learn through a variety of teaching decisions and approaches (Deci & Ryans, 2009). According to Wambugu, Changeiywo & Wachanga, (2010), there is need for classroom practices that would arouse the students' interest and attention, raise their expectancies of success in academic work and give them incentives and rewards that they value. A teaching method that would help students' to find satisfaction in the subject matter and also make the subject matter relevant to the needs of the leaner would be necessary to motivate them. It is important that a teacher adopts a teaching approach that will enhance the four dimension of motivation, namely attention, relevance, confidence and satisfaction to learn academic subject matter.

Mastery learning is one of several educational models in which students progress by mastering skills and knowledge at their own pace, rather than by passing courses based on a course grade on a uniform timeline. The mastery learning model is similar to standards-based education, proficiency-based pathways, and competency-based education (Priest, Rudenstine, Weisstein, & Gerwin, 2012). The term mastery learning is the foundational model from which subsequent competency models of learning were derived. Mastery learning requires five core components per instructional unit, pre-assessment, instruction, formative assessment, corrective or enrichment instruction, and summative assessment (Guskey, 2010).

Prior to the start of a unit, mastery learning teachers administer a brief pre-assessment to identify whether students have the foundational knowledge and skills needed for success in the upcoming unit. If students do not have the necessary prerequisite knowledge, the teacher may present remediation immediately for those students. If they do, the second component is to explain the new concepts of skills, demonstration and examples orallyand visually for a concept.This is followed by the third component, monitoring of students' progress through a formative assessment. This assessment identifies what students did and did not learn.

For the fourth component, the teacher provides brief corrective instruction (e.g., one or two days) to strengthen areas of student weakness as revealed by the formative assessment. Instruction for correction or enrichment usually takes place in a small-group setting or individually. The final component of mastery learning is a summative assessment. The summative assessment gives students a second chance to demonstrate mastery of the unit's concepts and skills and serves to evaluate the extent to which the corrective (or enrichment) instruction aided students (Guskey, 2010).

Similarly this instructional strategy is different from lecture method in which lecture methodinvolves verbal presentation of ideas, facts, concepts and generalization. The aim of the lecture method is to stuff the students with information. Teachers embrace this method because it affords an opportunity for easy coverage of school syllabus at a minimum expense of time.

Blooms mastery learning theory is a group based method. It differs from conventional classroom instruction in that:

1. It emphasizes mastery of all objectives in each learning unit.
2. It uses diagnostic progress test (formative test) to identify each learner's errors.
3. It uses systematic feedback i.e. correctives for helping learners overcome learning difficulties and finally, it provides additional time for those learners who need it, allows variation in learning-time and emphasizes high level of achievement for all learners.

Futher more, another focus of the study is to determine the differences in gender performance.Gender, according to Okeke (2008), is the social or cultural characteristics, roles or behaviour which males and females are known for by society. Onyegegebu (2008) referred to gender as the sum total of cultural values, attitudes, roles practices and characteristics based on sex. Onyegegebu further described sex as the innate biological differences between women and men. So both women and men differ by their physiology. Okeke (2008) described the men as bold, tactful, intelligent, aggressive etc and the women as dull, passive, submissive, talkative etc. These attributes affect their achievement in chemistry, because factors such as sex-role stereotyping, female socialization process, masculine images in chemistry textbooks exhaust could contribute to the observed differences in achievement of boys and girls. The difference could also be attributed to what Nnaka (2008) reported that girls do not get encouragement in science classes from the teachers, rather they make negative comments to girls about kind of work/course girls should undertake.

Although some researchers, for exampleMari, (2012) reported that girls did betters than boys in students' conceptual understanding of force and motion. Nnaka (2008) showed that girls had greater influence on their attitude towards chemistry than boys. On the other hand, Madu (2004), Iweka (2006), Obiekwe (2008), Agomaoh (2010) and Ukozor (2011) reported that boys achieved better than girls in sciences;' Other researchers, Okeke (2007), Viko (2002) and Omoniyi, (2006), showed that gender has insignificant effect on science achievement. Okoro (2011) opined that instructional method used in the classroom may influence gender and students' academic achievement in science. Okoro also further supported the argument that females performed better than males when co-operative learning strategy is used. On the other hand, when competitive or individualized learning strategy is used males did better than females. Similarly, Salami (2013) stated that what differentiates men and women are their ethical and behavioural approaches to their academic pursuits, social environment and traditional gender ideology. Alao and Abubakar (2010) opined that gender roles affect familiarity with academic content, career aspirations, attitude towards subjects, teacher's expectation and preferred approaches and these in turn affect academic performance. Considering all the above mentioned factors, it will be necessary to look at different teaching methodology to be able to identify which of the teaching approaches will enhance gender equality in achievement and createhigh motivation in both sexes.

Finally, motivation and gender are also strongly associated regarding students' academic performance. Carpusa and Lepperb (2007) did two studies on how gender and age moderates students' motivation levels regarding the stimulies or praise. They found that process praised enhanced motivation for girls but there were few effects of praise on boy's motivation improvement. So there is a need to include gender in thisstudy and explore whether there are many significant differences regarding male and female students exposed to mastery learning strategy in motivation and acadamic performance in chemistry among secondary school chemistry students. Therefore, this study was aim to investigate the effects of mastery learning strategy on senior secondary school chemistry students motivation and academic performance in karaye education zone, kano state Nigeria.

1.1.1 Theoretical Framework

The theoretical framework of this study was based on Bloom theory of learning for mastery (1968) in which he contended that the way students' progress was assessed was not helpful for their learning. He observed that instructors typically had the students take an assessment at the end of the instruction, which served to give the students a grade for their performance, but regardless of how the students did, he or she continued on into the next unit of instruction not minding his or her grade.
Mastery learning as a school of thought presumes that all children can learn if they are provided with the appropriate learning conditions. However, the concept of mastery learning is also rooted in the behaviourism principles of operant conditioning (Skinner, 1984 in Olorundare, et al., 2015). According to the operant conditioning theory, learning occurs when an association is formed between a stimulus and response. In line with the behaviour theory, mastery learning focuses on overt behaviours that can be observed and measured (Baum, 2005).

According to this theory, if the related introduction features of the student along with the teaching activities are positive, the learning output will reach a high level and the differentiation between the students. Three basic indicators of learning output could be identified in the work of Bloom (1984 in Olorundare, Oyelekan & Lamidi, 2015). These are cognitive introduction behaviours (i.e preliminary learning which is assumed to be a necessary pre-requisite for learning a concept); emotional introduction features (the extent of learner's motivation to learn); and the quality of teaching activity. In mastery learning, students are assisted by the teacher to master each learning unit before proceeding to the next which is more advanced. This instructional philosophy is based on the belief that all learners can learn if given the appropriate amount of time and the appropriate instructional opportunities.

It is on this background specifically the study examined, the effects of mastery learning instructional-strategy on motivation and performance of senior secondary school chemistry students in Karaye education zone Kano state, Nigeria.

1.2 Statement of the Problem

Chemistry as an academic discipline in Nigeria Secondary School is plagued with the problem of poor performance as a result of ineffective approaches use by chemistry teachers and lack of motivating students to learn chemistry by chemistry teachers. The failure in the chemistry is mostly in quantitative and qualitative aspect which poses problems. Nigerian secondary school student performance in chemistry has been poor and been unimpressive over the years (WAEC Chief Examiners Report 2014).

According to Olorukooba (2007) and Jegede (2007), students consider chemistry to be a difficult field of study. Students' inability to comprehend and remember what has been learned is mostly caused by the teacher-centered approach that makes learners passive listeners. The persistent use of traditional teaching method where chemistry teachers transmit knowledge to the students who most of the times are inactive in the classroom has not been promoting effective learning. Lack of motivation has been identified as one of the causes of poor performance in science. Glynn, Taasoobshirazi, and Brickman (2009) and Glynn, Taasoobshirazi, and

Brickman (2007) concluded that motivation to learn science positively related to secondary schools science performance.

Balancing of chemical equation, mole concept and its applications and periodicity of the elements constitute parts of chemistry concepts that teachers find difficult to teach their students, and students also find it difficult to understand (WAEC Chief Examiners Report, 2012). Science courses require students to recall many facts and then connect old and new concepts. Students often rely on surface strategies for memorizing facts, without any focus on content comprehension or connection,(Zeegers, 2001 & Gambari, 2004).

This poses a problem for senior secondary schools science teaching, because, if meaningful learning does not occur, students may not truly understand the material and ultimately make necessary connections for learning chemistry (Cavallo, Potter, & Rozman, 2004). The absence of meaningful learning may be due to the manner in which material is presented or to thelack of awareness of actual skills needed to reach meaningful learning levels (Gambari, 2013).Traditional instructional methods have given insufficient opportunities for students to construct their own learning. Eliciting students' individual capabilities, intelligence and creative thinking can only be achieved through student centered instructional methods (Adepoju, 2014).

Mastery learning instructional-strategy challenges the assumption that individual differences in school achievement are inevitable. Mastery leaning is design to ensure that nearly all students reach the same level of performance by repetitive applications of simple formula: plan-teach-test-re teach and retest.Thus, mastery learning is a group-based instructions followed by remedial techniques. The literature indicates positive effects of mastery learning on students, especially in the areas of motivation, performance, interests towards learning and retention of chemistry contents. Wachanga et al (2010) and Bloom (1984) have brought out effectiveness of mastery learning strategy at all levels of education and in such different subjects as Arithmetics, philosophy, Physics, Geography and Mathematics. Guskey and Jung (2011), analyzed the result of 46 studies on group based applications of mastery learning strategy and found that such applications yield consistently positive effects on both cognitive and effectiveness out comes.

However, what to find out in this study is how is mastery learningaffects motivation, to learn chemistry by gender.Therefore, there is need to explored effectsof mastery learning instructional-strategy on motivation and academic performance by gender among secondary school students in some selected schools in Karaye Education Zone Kano State.Therefore, the aim of this research work is to investigate the effect of mastery learning instructional strategy on senior secondary school chemistry students motivation towards learning and performance in Karaye Education Zone Kano State.

1.3 Objectives of the Study

This study was guided by the following objectives; to:

1. find out the effect of mastery learning instructional-strategy on the academic performance of senior secondary school chemistry students
2. find out gender, related diffeences of mastery learning instructional-strategy on the academic performance of senior secondary school chemistry students.
3. determine the effects of mastery learning strategy on motivation of students' taught chemistry through mastery instructional-strategy with that of students taught with lecture method.
4. determine whether students motivation is affected by gender, when students are taught chemistry through mastery learning instructionalstrategy.

1.4 Research Questions

The purpose of this study was to determine the effects of mastery instructional-strategy on senior secondary school chemistry students' motivation towards learning and performance. In achieving this purpose, answers were sought to the following questions:

1. What is the difference between the mean academic performance scores of students' taught chemistry using mastery learning instructional strategy and those taught using lecture method?
2. What is the difference between the mean academic performance scores of male and female students' taught chemistry using the mastery learning instructional-strategy?
3. What is the difference between the mean motivation scores of students taught chemistry using mastery learning instructional-strategy and those taught using lecture method?
4. What is the difference between the the mean motivation scores of male and female students taught chemistry using mastery learning instructional strategy?

1.5 Null Hypotheses

An attempt was made in testing the following hypotheses. The hypotheses formulated were tested at 0.05 alpha level of significance:

$H0_1$: There is no significant difference between the mean performance scores of students taught chemistry using mastery learning instructional strategy and those taught using lecture method.

$H0_2$: There is no significant difference between the mean performance scores of male and female students taught chemistry using mastery learning instructional-strategy.

$H0_3$: There is no significant difference between the mean motivation scores of students'taught chemistry using mastery learning instructional-strategy and those taught using lecture method.

$H0_4$: There is no significant difference between the mean motivation scores of males and females student who are exposed to mastery learning instructional-strategy.

1.6 Significance of the Study

It is hope that the finding of study will hopefully uplift the standard of chemistry education in the following ways:-

i. **Curriculum planners**: The study will motivate the curriculum planners of senior secondary school chemistry to emphasize the use of mastery learning instructional-strategy in teaching various concepts in chemistry. This may help to enhance the performance in chemistry reducing the rate of failure in the subject.

ii. **Researchers:**This study will close the gap in literature that will call for further researches and also background knowledge to depend on.

iii. **Students**: the finding of the research work will enhance motivation of chemistry education students towards the subject and improve their academic performance since it incorporate mastery of the concepts taught.

iv. **Teacher**: the finding of the study will be hopefully to be useful to chemistry teachers who will improve their teaching strategy in order to enhance academic performance and arose students motivation towardslearning chemistry at all educational levels.

v. **Text Book Publishers**: the authors of chemistry text books in Nigeria will find this study useful because it will help them to impose appropriate teaching strategies in their text books since other teaching strategies are becoming unmotivated among the chemistry students.

vi. **Professional bodies**: The result of this study will benefit federal and state ministries and other educational bodies like Nigeria Educational Research and Development Council (NERDC) and Science Teachers Association of Nigeria (STAN) to organize training/workshop for teachers so as to update their knowledge on the use of mastery learning instructional-strategy to improve teaching and learning in Nigerian schools.

1.7 Scope of the Study

This research was aimed to determine the effects of mastery learning instructional-strategy on senior secondary school chemistry students' motivation towards learning and performance in Karaye education zone Kano state. The study was carried out using SS II students in Karaye education zone Kano state.

All the secondary schools selected offer WAEC and NECO examinations where the secondary school chemistry syllabus is used. Only students offering chemistry with other science subjects are selected for the study. In addition only four schools in the study area were sampled for the study. The justification for using SSII students in this study was because the target group are stable unlike SS I who are not fully settles for the study, nor SS III students who were facing the final year examination. This is because at thislevels in the school the students would have been to exposed to many chemistry topics. The topics that were covered in theChemistry Students Performance

Test (CSPT) were mole and Avogaros number, mole – mass number conversion, volume – amount in gases and mole concept. These topics mastery have been identified as difficult for students to learn by WAEC chief examiner's report (2010-2015). Therefore, in this study the researcher investigated the effect of mastery strategy on senior secondary school chemistry students' motivation towards learning and performance in Karaye education zone Kano state.

1.8 Basic Assumptions of the Study

For the purpose of this study, the following assumptions were made that:

i. The use of mastery learning instructional-strategy is a learner-centred and therefore, could improve the mastery of concepts by the chemistry students.

ii. Mastery learning instructional strategy can effectively be carried out in secondary schools.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This study examined the effects of masterylearning strategy in senior secondary school chemistry students' motivation towards learning and performance. This chapter was therefore review some literatures related to this study under the following sub-headings:

2.2 Meaning and Scope of Chemistry as a Discipline at Secondary School Level.

2.3 Concept of Mastery Learning.

2.3.1 Components of Mastery Learning Instructional Strategy.

2.3.2 Mastery Learning and Performance in Chemistry.

2.4 Concept of Motivation.

2.4.1 Students Motivation and Performance in Chemistry

2.4.2 Mastery Learning and Motivation in Chemistry

2.5 Gender-Related Differences in Learning Chemistry.

2.6 Overview of Similar Studies.

2.7 Implication of the Literature Reviewed for the Present Study.

2.2 Meaning and Scope of Chemistry as a Discipline at Secondary School Level

Science teaching in Nigeria dated back to 1867 when Nature Study and Hygiene were introduced as school subjects. These later became Biology, Chemistry and Physics (Erinosho, 2008). Chemistry was thus among the three basic sciences introduced into Nigerian secondary schools by the colonial government. Central to the teaching of science and technology in schools is chemistry (Achimugu 2011). Chemistry as a branch of science deals with the study of the properties, and composition of matter, and how these undergo changes (Omiko, 2011). According to Olorukooba (2007) and Jegede (2007), students consider chemistry to be a difficult field of study. Students' inability to comprehend and remember what has been learned is mostly caused by the teacher-centered approach that makes learners passive listeners. The persistent use of traditional teaching method where chemistry teachers transmit knowledge to the students who most of the times are inactive in the classroom has not been promoting effective learning. Lack of motivation has been identified as one of the causes of poor performance in science. Glynn, Taasoobshirazi, and Brickman (2009) and Glynn, Taasoobshirazi and Brickman (2007), concluded that motivation to learn science positively related to college science performance.

Balancing of equation, mole concept, chemical laws and periodicity of the elements constitute parts of chemistry concepts that teachers find difficult to teach their students, and students also find it difficult to understand (WAEC, 2012). Science courses require students to recall many facts and then connect old and new concepts. Students often rely on surface strategies for memorizing facts, without any focus on content comprehension or connection,(Zeegers, 2001 & Gambari, 2004). This poses a problem for college science teaching, because, if meaningful learning does not occur, students may not truly understand the material and ultimately make necessary connections for solving problems (Cavallo, Potter, & Rozman, 2004). The absence of meaningful learning may be due to the manner in which material is presented or to the lack of awareness of actual skills needed to reach meaningful learning levels (Gambari, 2004).In Nigeria, chemistry as a subject is being taught starting from the post basic level of the educational system. At the basic level, chemistry is taught as an integral part of basic sciences.

The importance of chemistry teaching in science and technological development cannot be overemphasized, as chemistry is reputed as being central to the understanding of the other physical sciences owing to its confluence with and influences on the other natural sciences such as physics, biology and geology (Ahiakwo,2002& Reinhardt,2001). Edeh and Vikoo (2013) had equally asserted that practically all forms of human endeavours and everything in science involves the application of chemistry.The central role that chemistry plays among the sciences and technology can be discerned from the fact that to gain admissions into any programme in the (physical &biological) sciences, technology, engineering, agricultural and medical science programmes in any institution of higher learning in Nigeria requires at least a credit pass in chemistry (JAMB Report, 2013).

Considering the central role that chemistry plays especially as regards to sciences at the senior secondary school level as well as its roles as parts of the core admission requirements to higher institutions across the African educational systems and especially in Nigeria, it would thus be expected that senior secondary school students' performance in the subject would be high.Astonishingly, available reports of students' performance across West Africa reveal that senior secondary school students' results in public examinations in chemistry in Nigeria, Sierra Leone, Ghana, Liberia and Gambia had consistently been getting worse. Most often, at least 70% of candidates that registered for the examination have not been able to pass (WAEC, Chief Examiners Report, 2012).Various factors have been attributed to students' consistent abysmal performance in school science and mathematics subjects especially chemistry at the senior secondary level (WAEC, Chief Examiners Report, 2011). Chief among the contributing factors being the approaches used by chemistry teachers and lack of motivation which tend to make chemistry concepts to be too abstract and uninteresting to students as well as the general perception of chemistry topics by students (Sjoberg 2002). Another being that chemistry is generally perceived difficult to learn by students. Jimoh (2005), as an example reported that senior secondary school chemistry students perceived 65% of the topics in the senior secondary chemistry curriculum difficult to comprehend. Thus most often, students tend to view concepts in chemistry as being too volatile as they often are unable to remember them (Adepoju, 2014).

According to the National Policy on Education (FME, 2013) the broad aim of the senior secondary education is: preparation for useful living in the society and preparation for higher education. Chemistry is very necessary for the realization of these aims. Chemistry prepares professionals such as Medical Doctors, Pharmacist's, Chemistry Teachers, Chemical Engineers and Biologists Engineering. Chemistry is also very useful for living in the society. One has to choose the texture and colour of cloths to wear, the food to eat, the taste of the food and the make - up, the acidic and basic properties of such food, the water to drink, the fertilizer, herbicides to apply and so on. Chemistry therefore equips the individual with necessary knowledge, skills and attitudes to enables, him/her interact meaningfully with the environment, and solve life problems in the society. One is expected after studying chemistry at the senior secondary school level to be self reliant and help to build the Nigerian nation scientifically and technologically. The knowledge of chemistry should help the recipients to go into the manufacturing and processing of industries. Chemistry deals with manufacturing and processing of many organic materials such as petrol and synthetic materials.

Okonkwo (2010), reported that the reason for the failure in chemistry is due to inappropriate teaching methods used by the teachers. Florence (2013), reported that students found chemistry too difficult. When concepts in chemistry appear too difficult and students achieve poorly, one may be forced to conclude that students do not remember the facts or concepts learnt during examinations. Students were taught by the teachers, they read and prepared for the examination but coming to the pubic examination hall, they forget the facts, concepts and principles. All branches of science have important contribution to make in a nation's technological advancement. Jantur (2005) pointed out that chemistry is presumed to be the fulcrum on which all science and technology disciplines and careers hinged for national development. This is due to the ability of Chemistry to explain matter from the elementary particles, and thus deal effectively with science concepts and principles regarding natural phenomena in the environment.

The world is a chemical world because everything in the environment consists of one chemical substance or the other. Therefore, there is no gainsaying that the role of chemistry in science and technology for industrial and overall development of any nation cannot easily be underestimated. As a result Jegede (2007), stressed that chemistry occupies a central position among the sciences due to its remarkable contribution in medicine, pharmacy, textile industry, engineering, petroleum and agriculture to mention but a few. Consequent upon this, Nigeria hopes to achieve technological development and self-reliance for her citizens through science and chemical education.Although chemistry has been identified as a fulcrum on which all other sciences and technology hinged for industrial and national development, it has been plagued with gross under achievement by students over the years, (Inyang & Ekpenyoung, 2000). Thus the poor performance in chemistry has crippled the realization of national goals for scientific and technological development.

However, the enviable position which science education system of most countries of the world, including Nigeria is perhaps justifiable. The reason is that science can exert a dominant, if not decisive influence on the life of individual as well as on the developmental effort of a nation (Adesoji, 2008). The universal recognition of the above submission is responsible for the prime position that has been accorded science and in particular, chemistry worldwide. Within the context of science education, chemistry has been identified as a very important school subject and its importance in scientific and technological development of any nation has been widely reported.

It was as a result of the recognition given to chemistry in the development of the individual and the nation that is made a core - subject among the natural sciences and other science- related courses in the Nigerian education system. Its inclusion as a subject in science in the secondary school calls for the need to teach it effectively. This is because effective science teaching can lead to the attainment of scientific and technological greatness.Chemistry teaching can only be result-oriented when students are willing and the teachers are favourably disposed, using the appropriate methods and resources in teaching the students. With the current increase in scientific knowledge the world over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science.

Despite the importance of chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria. Among the factors that have been identified outcomes in chemistry are, poor methods of instruction (Adesoji, 2008), teachers attitude,(Aghadiuno in Adesoji, 2008), laboratory in-adequacy,(Adeyegbe, 2005), and poor science background (Adesoji, 2008). However, Papanastasiou (2001) reported that those who have positive motivation toward science tend to perform better in the subject. The affective behaviours on the classroom and strongly related to achievement, and science attitudes are learned. According to Adesoji, (2008), the teachers play a significant role during the learning process and they can directly or indirectly influence the student's motivation toward chemistry which in consequence can influence students' performance.

Teachers are invariably, role models whose behaviours are easily mimicked by students. What teachers like or dislike, appreciate and how they feel about their learning or studies could have a significant effect on their students. By extension, how teachers teach, how they behave and how they interact with students can be more paramount than what they teach.Student's motivation toward the learning of chemistry is a factor that has long attracted attention of researchers. Adesokan (2002) asserted that inspite of realization of the recognition given to chemistry among the science subjects, it is evident that students still show negative attitude towards the subject, thereby leading to poor performance and low enrolment.The achievement of students in chemistry is also reported to be causally influenced by the previous experience of the students in integrated science. A student cannot learn chemistry effectively without going through some experiences in integrated science (Adesoji 2008).Other factors that may have causal relationships with students academic performance is science, particularly, chemistry include teacher attendance at chemistry workshop, laboratory adequacy, class size and school location.

2.3 Concept of Mastery Learning

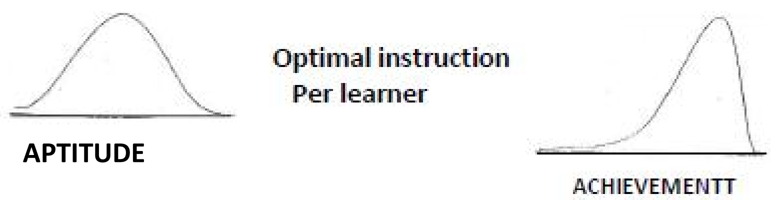
Mastery learning is an educational approach that was pioneered in the 1920s and expanded upon and formalized by Bloom in the 1960s.Pearson and Michael

(2014), observed that in a traditional learning environment, a teacher presents information uniformly to a class of students over a set amount of time. While the instruction and the information presented do not vary in the traditional environment, students' aptitude for learning does vary. As a result, some students are more successful than others on their final exams (Guskey, 2007). Bloom (1968),proposed a new approach to instruction: "Learning For Mastery" (LFM), or Mastery Learning. Under a mastery learning framework, teachers and students have flexibility to work at a pace necessary to master the current topic or concept, as determined by a specified threshold on a project or exam, often around 80 percent. After a first round of assessment, teachers provide appropriate remediation, sometimes called "correctives," or enrichment to students based on their needs, then administer another assessment. This cycle repeats as needed. Students progress to new concepts after demonstrating mastery of the current ones.

Mastery learning is an instructional method that presumes all learners can learn if they are provided with the appropriate learning conditions. Specifically, mastery learning is a method whereby students are not advanced to a subsequent learning objective until they demonstrate proficiency with the current one (Guskey, 2010). Bloom's (1968), Mastery learning was derived from John B. Carrols model of school learning in 1963. Bloom transformed this model into an effective working model for mastery learning. He argued that, if students were normally distributed with respect to aptitude for a subject and if they were provided uniform instruction in terms of quality and learning time, achievement at completion of the subject would be normally distributed. This can be illustrated as shown below:

Source: (Uche et al., 2012).

He explained further that if students were normally distributed on aptitude but each learner received optimal quality of instruction and the learning time he required then a majority of students could be expected to attain mastery. There would be little or no relationship between aptitude and achievement. Bloom's idea is based on the fact that if each learner receives optimal quality of instruction and learning time required, majority of students will attain mastery. This situation can be represented as follows:



Source: (Uche et al., 2012).

To Bloom, many educators have consistently used the normal curve in grading students but as he explained if educators are effective in their instruction, the distribution of achievement should be very different from the normal curve. According to him one can regard as unsuccessful any educational effort which approximates the normal distribution. Mastery learning offers a powerful approach to learning which can provide all learners (more than 90 percent) with successful and rewarding learning (Uche *et al.,* 2012).. Bloom condemns a situation where it is expected by teachers that some students will be successful and some will not. Mastery learning proposes that all or almost all students can master what they are taught. It suggests procedures whereby a learner's instruction can be managed so as to promote its fullest development. Thus as a result generates positive interest and motivation towards the subject learned than usual classroom method (Uche *et al.,* 2012).

Bloom predicted that because instruction varies with student needs, students would achieve uniform high performance using Learning For Mastery (LFM), (Pearson et al, 2014).

Mastery learning is one of several educational models in which students progress by mastering skills and knowledge at their own pace, rather than by passing courses based on a course grade on a uniform timeline. The mastery learning model is similar to standards-based education, proficiency-based pathways, and competency-based education (Priest, Rudenstine, Weisstein, & Gerwin, 2012). The term mastery learning is used because it is the foundational model from which subsequent competency models of learning were derived. Mastery learning requires five core components per instructional unit: Pre-Assessment, Instruction, Formative Assessment, Corrective or Enrichment Instruction, and Summative Assessment (Guskey, 2010). The figure I below shows the learning cycle for mastery learning instructional unit.

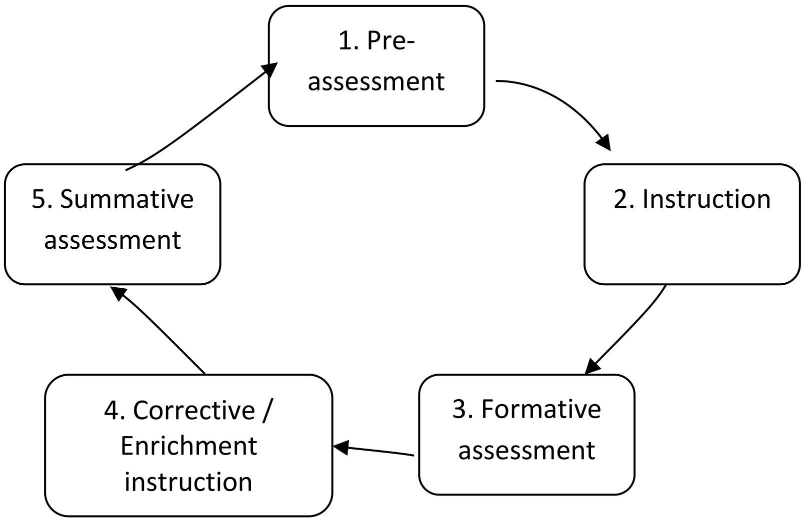


Figure 1: Mastery learning cycle for an instructional unit

Source: Guskey (2010)

Prior to the start of a unit, mastery learning teachers administer a brief pre-assessment to identify whether students have the foundational knowledge and skills needed for success in the upcoming unit. If students do not have the necessary prerequisite knowledge, the teacher may present remediation immediately for those students. If they do, the second component is general group instruction on the unit's content. This is followed by the third component, monitoring of students' progress through a formative assessment, typically administered after one to two weeks of instruction. The assessment identifies what students did and did not learn.

For the fourth component, the teacher provides brief corrective instruction (example, one or two days) to strengthen areas of student weakness as revealed by the formative assessment. Or, if students demonstrated mastery on the formative assessment, they receive enrichment activities that offer challenging learning experiences beyond the mastery level. Instruction for correction or enrichment usually takes place in a small-group setting or individually. The final component of mastery learning is a summative assessment.

The summative assessment gives students a second chance to demonstrate mastery of the unit's concepts and skills and serves to evaluate the extent to which the corrective (or enrichment) instruction aided students. Students repeat the fourth and fifth components until they demonstrate mastery (Guskey, 2010). Each instructional unit typically takes about two weeks, although the length of time to achieve mastery necessarily varies by student. This five-component cycle repeats throughout the length of the course for each new unit. Research to date on the effects of mastery learning is inconclusive. Several studies have found positive effects on student performance, attitudes, and behavior (Ironsmith & Eppler, 2007; Changeiywo, Wambugu, & Wachanga, 2010; Wambugu & Changeiywo, 2008). Meanwhile, other studies, often involving stricter study requirements, found limited or no effect on student performance or affect (Deweese, 2012).

The most comprehensive look at mastery learning reviewed studies of Bloom's group-based LFM, Keller's PSI, K–12 and college instruction, and long-term and short-term interventions (John, Barchok & Ng'eno, 2014). Using a meta-analysis approach, the authors estimated that mastery learning has a statistically significant positive effect on student final examination scores. Specifically, LFM raised test scores by 0.52 standard deviation, meaning mastery learning has a moderate positive effect. In contrast, Slavin, in Pearson et al, (2014) used a more restrictive meta-analysis that reviewed only LFM, K–12, and long-term approaches to mastery learning measured by standardized assessments.

According to Pearson et al,(2014), the effects of mastery learning on student performance appear to vary by student characteristics and course content. Mastery learning appears to benefit low-performing student's more than high performing students. An average, student with high initial test scores improved by 0.40 standard deviation, whereas students with low initial test scores improved by 0.61 standard deviation.

In addition, some authors have suggested that mastery learning is more effective for hierarchical, sequential courses such as math, physics, chemistry, English, and possibly art (Changeiywo et al., 2010; Deweese, 2012), though the earlier meta-analysis suggested mastery learning may not be as effective for math and science as for other courses (Pearson, et al 2014). Research suggests that in addition to student performance, mastery learning instruction can improve various aspects of student effect and meta-cognition. These aspects include motivation, self-regulation, self teaching, sense of control, resilience, and attitude toward the content and instructor,(Ironsmith & Eppler, 2007; Zimmerman & DiBenedetto, 2008; Changeiywo *et al.,* 2010; Guskey, 2010).

The mastery learning approach to instruction also is associated with a small increase in instructional time, which appears related to the improvements in performance. That is, a key component of mastery learning is the additional corrective or enrichment instruction provided to students after formative assessments. These activities can increase the amount of class time teachers spend with students reviewing and re-teaching unit concepts, especially for early units when students are acquiring foundational knowledge. The meta-analysis by Pearson et al, (2014) found that on average, mastery learning increased instructional time by four percent relative to traditional instruction. The increased instructional time may result from adjusted class periods within the school day, additional instruction beyond the school day, or a slower pace of instruction.

Guskey (2007) further discusses that corrective instruction may increase instructional time early in a course, but as students become accustomed to the mastery learning instructional cycle and attain mastery of foundational concepts and skills, fewer students will need correctives in later units. He does not quantify the expected changes to instructional time at different points in a course or the overall effect on instructional time.

Mastery learning is an instructional strategy in which learners are provided with the opportunity to master a particular unit of lesson before proceeding to the next. Mastery learning instructional strategy divides subject matter into units that have predetermined objectives or unit expectations. Students, alone or in groups, work through each unit in an organized fashion. The teacher assesses and grades the students after each unit to determine who has mastered the content and who needs more help. Students must demonstrate mastery on unit exams, typically 80%, before moving on to new material (Anderson, 2000).

Students who have mastered the material are given enrichment opportunities which could be in the form of projects or problem solving tasks. Students who do not achieve mastery receive remediation through tutoring, peer monitoring, small group discussions, or additional assignment. Additional time for learning is prescribed for those requiring remediation and students continue the cycle of studying and test many studies have been conducted to determine the effectiveness of mastery learning instructional strategy on learners' learning outcomes. In fact, Guskey and Gates (1986),in Pearson, et al (2014),reviewed25 studies conducted in this area at the elementary and secondary school levels using a meta-analysis technique.

They all found that, the 25 studies reported positive effects of mastery learning on students' achievement. Students with minimal prior knowledge of material had higher performance through mastery learning than with traditional methods of instruction (Pearson et al, 2014). In a study conducted in Kenya by Wambugu and Changeiywo (2008) sought to find the effects of mastery learning on the performance of secondary school students in Physics. They found that students taught Physics through mastery learning had higher performance than those not taught with mastery learning. Similar results were obtained by Ngesa (2002); Oloyede and Demide (2000); Wachanga and Gamba (2004). For instance, Kulik, Kulik and Bangert-Downs in Pearson, et al (2014). Conducted a meta-analysis involving 108, evaluations mastery learning programmes. They found that mastery learning generally had positive effects on students' performance. Their study further revealed that the effects of mastery learning were not uniform on all students in a class, as low aptitude students were found to have higher gains than high aptitude students.

2.3.1 Components of Mastery Learning Instructional Strategy by Bloom (1968)

The Mastery learning approach has five (5) main vital components namely the pre-assessment instruction, formative assessment, correction and the summative assessment.

Phase One: Pre-assessment: the framework for the lesson is established as follows:

a. Provide objectives of lesson and level of performance required.

b. Describe the content of the lesson and relationship to prior knowledge and experience.

c. Discuss the procedures of the lesson - the different parts of the lesson and student's responsibility during each activity.

The mastery approach places considerable emphasis upon the selection of the objectives, because objectives determine the content and amount of instructional time. (Joyce 2006), found that relevant learning was greater when students were provided with objectives prior to the beginning of the instruction. Objective must be defined in behavioural and measurable terms so that success of the programme may be assessed exactly and accurately. Objectives are presented as specific statements of the goals or outcome that the students are expected to reach.

It also defines the specific skills, the key concepts the basic ideas and the specific facts that the students must learn in order to complete the programme successfully, A minimum pass level of performance is essential for students identification. The performance level is called mastery level or minimum pass level. The level of performance expected from the students at the end of each instructional unit must be defined very clearly. The minimum pass level which may be considered reasonable for each learner should not be less than 70% before moving to another level.

Phase Two: Instruction: explain the new concepts or skills, demonstration and examples orally and visually for a concept, include attributes (characteristics). The rule or definition, and several examples for a skill, identify the steps of the skill with examples of each. It is important that pupils have a visual representation of the task (VRT) in the early stages of learning. This determines each students starting point, which in turn could determine the method of instruction to be used for different groups. Thus the pretest help in identifying; the areas of weakness strengths of the students before the programme takes off. Goals and objectives of programme and the selection of the material and instructional method are also determined as a result of presentation. Joyce (2006), found that students scores on pre-test were significantly related to the time required to complete the programme or assignment on chemistry. Students develop more positive attitudes about learning and about their ability to learn depending on time and motivation, and interest exist when concepts or skills are clearly demonstrated and defined.

Phase Three: Formative assessment: lead students through practice examples working in a lock-step fashion, each step of the task as it appears in the visual representation of the task (VRT) (e.g. use an over head projector during practice examples, so that students can see the generation of each step. Then provide a visual instructional plan (VIP) in which each step is given in detail to the students which will enable them get stuck in individual practice or independent practice). This can be refers to the VRT while working practice examples as a group.

Structured practice depends on instructions. Instruction can be adapted to the needs of the individual student. The component must be implemented in conjunction with the prescriptive component if the informationobtained is to have significant impact upon students learning. No matter what type of instruction is used, it is not likely to be efficient in students towards mastery unless the instruction is of good quality. Carroll, (1963) in Joyce (2006), studied the effect of high and low quality of instruction on learning. The results indicated that, students required time to achieve mastery when they use the low quality instruction. Bloom (1984) in Wachanga et al (2010), opined that only instructional materials and methods encourage students to participate actively in the learning process should be adopted. Joyce (2006), reviewed carefully the appropriate teacher qualities for successful instruction as follows, clarity of presentation, variety of teacher-initiated activity, enthusiasm of teacher, teacher emphasison learning and achievement, audience of extreme criticisms, positive response from the students, students opportunity to learn criterion material, use of structure components by the teacher, use of multiple level questions.Then the instruction would be successful no matter how.

By implications, the learning process is more efficient when the instruction is of good quality and instructional methods and materials are matched to the needs and learning style of the students. To ensure the quality of good instruction, diagnostic evaluation follows. This assessment measures what each student has learnt and what he/she has failed to learn. It should take place at regular intervals at the end of each unit, throughout the instructional programme. The information is used to improve upon those segments of the instruction that have not been effective. Instruction can be adopted to the needs of the individual students.

Phase Four: Correction/Enrichment: in class, "seat work" with the teacher circulating (e.g. praise, prompt, and leave"). Monitor students' work, providing corrective feedback as necessary, and assess performance of the group in determining whether the class is ready for the next instruction. Additional time for those whose aptitude calls for a longer learning period can be provided by giving extra credit assignment, supplementary activities so as to develop more pre-requisite skills.

When a student does not demonstrate mastery on a formative assessment measure, the 'students' problems need careful analysis in order to determine the appropriate prescription. He/she continues recycling through the remediation and diagnostic until he/she performs at the minimum pace level.

Phase Five: Summative assessment (additional class time or homework) begins when students have achieved an 85% to 90% accuracy level. To ensure motivation and develop fluency, students practice on their own without assistance and without delayed feedback e.g. comments on graded papers. Five or more brief practice activities distributed over a month or more may be required to fix new concept or skill.

Advocates of mastery learning instructional-strategy have proposed that almost all students can acquire adequate levels of the basic skills taught in the normal school curriculum when mastery learning procedures are used. Bloom and Carroll (1974), said that the student who performs at the minimum pass level on the summative evaluation in a course is evaluated as one who has performed successfully in the course, therefore, the students is fit for the next course on the programme and if n student has failed to attain a minimum pass level or failed to master a crucial objective, the student is rejected through the instructional programmed, therefore additional instruction is prescribed. The student will continue to receive instruction until the minimum pass level is reached.

The Procedures for Mastery Learning as Designed by Bloom (1968)

STEP 1: Break the course or subject into smaller units, such as a chapter in a textbook, awell defined segment of content which may involve one to two weeks oflearning activity. The units should range from specific terms or facts to morecomplex and abstract ideas such as concepts and principles to more complex processes such as application of principles and analysis of theoretical statements. Such elements are considered as forming hierarchy of learning tasks. It is very necessary that students have mastery of unit one before moving to unit two.

STEP 2: Determine unit objectives and mastery level i.e. the optimal learning level expected for the learners before they will move to the next unit.

STEP3: Construct formative test for each unit to determine which of the units tasks the students has mastered or not mastered. At this level students are informed that the tests are used to determine their mastery of a particular unit and are not graded.

STEP 4: The formative test is determined and scored using items like mastery and non mastery. Use of grade is avoided to remove tension and anxiety on the learners. For students who have thoroughly mastered the unit, the formative test reinforces their learning and assures them that their learning approach and study habits are adequate. The formative test also reduces anxiety about end of course achievement for learners who consistently demonstrate unit mastery. For the learners who lack mastery of the unit, the formative test reveals the particular areas of difficulty and the ideas, skills and processes still needed to work on. The formative test also provides feedback to the teacher, because they can be used to identify particular points in the instruction that need modification. It can also serve as quality control in future cycles of the course, the students performances on each test may be compared with the norms for previous years to ensure that they are doing as well or better.

STEP 5: Use corrective learning procedure for learning difficulties discovered after the administration of formative test. The correctives are designed to re involve the learners in learning the course unit in ways that differ from the original group based instruction. This makes it possible to adapt instructional methods and materials to the need of all learners, improves interest, motivation, attitude, perception and shifts the entire achievement distribution upwards. Some of the corrective learning procedures include small group study session, tutorials, rereading particular pages of the original instructional materials, studying specific pages or workbooks or programmed materials, use of flash cards, re-teaching etc. The learners learn which correctives that work best for them and their later learning becomes more efficient. The extra time spent pays dividend on later learning.

STEP 6: After using the necessary corrective learning procedures, the formative test is re-administered on the learners to determine the effect of the procedures on them. If the majorities have attained mastery, the class moves to the next unit.

2.3.2 Mastery Learning and Performance in Chemistry

Ngesa (2002) conducted a study to find out the impact of experiential and mastery learning programs on academic performance in secondary school Agriculture in Kenya. The result indicated higher student achievement in Agriculture than the regular teaching method. Similarly, Tim (2014) studied the effects of using group mastery learning on the achievement of high school biology students. They found that in group mastery learning students did better in some topics as compared to individualized mastery learning, although their method focused on students' co-operative skills than mastery of the content. A related study by Wambagu and Johnson (2007) focused on mastery of physics content through corrective feedback and remediation rather than cooperative skills but the results showed that mastery learning is superior to Regular Teaching Method in terms of achieving higher scores.

Similarly research conducted on comparing effects of mastery learning alone, and Regular Teaching Methods on students' Achievement in Mathematics by Mevarech in Pearson, et al (2014) showed that mastery learning was the indicator that significantly increased achievement. Research reports on students' achievement in science on the basis of gender are inconclusive. Many researchers (Loofa, 2001; Freedman, 2002; Arigbabu & Mji, 2004, Bilesanmi-Awoderu, 2006) have provided reports that there are no longer distinguishing differences in the cognitive, affective and psychomotor. Learners generally operate at different levels of intelligence and their ability to perform specific tasks also differs. According to Pearson, et al (2014) all aspects of science could be said to be problem solving and students have varying ability when they are confronted with problems to solve.

Salami (2013) stated that problem solving in science depends on students' cognitive ability level. An intelligent person is someone who can solve a whole variety of difficult questions rapidly. As a matter of fact, there is a strong relationship between the level of individual's intelligence and his mastery of a given task. There is need for good instructional strategies that goes a long way in improving learning skills of students no matter their ability level until mastery is achieved after which they can proceed to more advanced learning tasks. However, the developers of mastery learning assert that it is most useful with the basics skills and slow learners at both elementary and secondary levels. Bloom challenges the assumption that individual differences in school achievement are inevitable. Mastery Learning is designed to ensure that nearly all students reach the same level of achievements by repetitive applications of the simple formula: plan- teach- test-re teach and retest. Thus, mastery learning is the group-based instructions followed by remedial techniques.

The literature indicates positive effects of mastery learning on students, especially in the areas of achievement, motivation toward learning, and the retention of content. School systems that have implemented mastery learning have found it to be a very effective teaching and learning method. Joyti and Soritis (2014) have brought out the effectiveness of Mastery Learning Strategy at all levels of education and in such different subjects as Arithmetic, Philosophy, Physics and Geography. Guskey and Gates (1986) in Joyti et al, (2014) analyzed the results of 46 studies on group based applications of Mastery Learning Strategy and found that such applications yield consistently positive effects on both cognitive and effectiveness outcomes. Joyti et al, (2014) made a meta-analysis of 108 studies on the effectiveness of mastery learning programs. They also found that mastery-learning programs have positive effects on pupil's achievements, motivation towards instructional method and motivation towards subject. Other researches on mastery learning in schools have also shown positive cognitive learning outcomes in students (Akinsola, 2007; Kazu, Kazu & Ozedemi, 2005).

Abadom (2002) reported that results of studies using Bloom's Learning For Mastery (LFM) approach showed that the mean score for the mastery learning group is usually at least one standard deviation higher than the mean score of the conventional teaching method group. This agrees with Adeyemi (2007) who studied the effectiveness of learning social studies through mastery learning approach on students' performance in social studies using two groups of 200 level students from a University in Nigeria and a study centre of the same University. He found that students taught with mastery learning in the two groups performed better than students taught with the conventional approach to teaching. Another study was conducted by Ogan (2012) on the effect of mastery learning on senior secondary school achievement in Geography and he found that the mastery learning group performed better than the control group (conventional teaching method). Lawal (2002) also did a study on mastery learning titled, 'effects of three instructional strategies on cognitive learning outcome of students in mathematics' and found that mastery learning was very effective in enhancing students' performance irrespective of their sex.

In the same vein, Wachanga and Johnson (2008) studied the effects of mastery learning approach and gender on students' performance in physics using two groups of students in co-educational schools. One group (experimental) was taught with mastery learning approach and the other group (control) was taught with conventional teaching method. They found that the group taught with mastery learning performed better than the group taught with the conventional teaching method. They also found that there was no significant effect of gender on the performance of the students and concluded that mastery learning is an effective teaching method, which physics teachers should be encouraged to use. Ogba (2000) studied the effect of mastery learning on cognitive learning outcomes of junior secondary school mathematics and found mastery learning better than conventional teaching method. Also Adeyemi (2007) described mastery learning as a teaching strategy that involves a pre-specified criterion level of performance which students must master in order to complete the instruction and move on.

According to him, mastery learning involves frequent assessment of students' progress, it provides corrective instruction and emphasizes on all participation, feedback and reinforcement. In the same vein, Wambugu and Changeiywo (2007) opined that MLA helps the students to acquire prerequisite skills to move to the next unit. Mastery of each unit is shown when the students acquire the set pass mark of a diagnostic test. The teacher is also required to do task analysis and state the objectives before designating the activities.

In order to motivate students participation, mastery learning makes it possible to achieve all details in the objectives, adapt instructional methods and materials to the need and characteristics of all learners, works to improve intrest, motivation, attitude, and perception, shift the entire achievement to be improve, get the learners immuninized against failure, create opportunities for fullest and future development and encourages confidence in continuous learning and training. This is in line with philosophy of chemistry which is development oriented, emphasizes life-long education and continuing education throughout the life.

2.4 Concept of Motivation

Motivation refers to "the reasons underlying behavior" (Guay, Chanal, Marsh, Mlarse & Bolvin, 2010). Paraphrasing, Broussard and Garrison (2004) broadly define motivation as "the attribute that moves us to do or not to do something". Motivation is animated by personal enjoyment, interest, or pleasure. As Emily (2011) observe, "intrinsic motivation energizes and sustains activities through the spontaneous satisfactions inherent in effective volitional action. It is manifest in behaviors such as play, exploration, and challenge seeking that people often do for external rewards". Researchers often contrast intrinsic motivation with extrinsic motivation, which is motivation governed by reinforcement contingencies. Traditionally, educators consider intrinsic motivation to be more desirable and to result in better learning outcomes than extrinsic motivation (Emily, 2011).

Motivation involves a constellation of beliefs, perceptions, values, interests, and actions that are all closely related. As a result, various approaches to motivation can focus on cognitive behaviors (such as monitoring and strategy use), non-cognitive aspects (such as perceptions, beliefs, and attitudes), or both. For example, Emily (2011) defines academic motivation as "enjoyment of school learning characterized by a mastery orientation; curiosity; persistence; task-endogeny; and the learning of challenging, difficult, and novel tasks". On the other hand, Gambari, (2016) considers motivation to be synonymous with cognitive engagement, which he defines as "voluntary uses of high-level self-regulated learning strategies, such as paying attention, connection, planning, and monitoring".

Motivation is one of the states that drives and sustains learning behaviors. There are many motivational constructs that could relate to academic success in school. However, researchers have identified intrinsic and extrinsic motivation, goal orientation, task value, self-determination, self-efficacy, and assessment anxiety as important constructs for science learning (Glynn & Koballa, 2006; Glynn et al., 2009).

However, the present study focused on motivation as predicator of success in chemistry, using mastery learning instructional strategy.

Intrinsic motivation refers to internal desires to perform a particular task which is rewarded by completing the task itself, whereas extrinsic motivation refers to performance of a task in order to receive an external reward (Ryan & Deci, 2000). In academic situations, intrinsic motivation leads to deeper processing, greater mastery, and better implementation of learning strategies (Covington, 2000). Intrinsically motivated students are also more likely to persist with challenging tasks and other positive classroom behaviors as well as perform better academically than extrinsically motivated students who might have to been bribed before they perform the given tasks (Deci & Ryan 2000; Walker, Greene, & Mansell, 2006).

Extrinsic motivation generally drives behaviors when students complete tasks for an external outcome. Extrinsically motivated students who fall closer to active personal commitment on the continuum may be driven to act primarily because of the reward. However, these rewards may also have some intrinsic elements, for instance, receiving an 'A' makes the student feel good (Walker et al., 2006).

Motivation to learn chemistry at the Secondary School level is one of the most important predictors of science course success (Britner & Pajares, 2006). Moos (2010) reported that participants who had high extrinsic and high intrinsic motivation used significantly more planning and monitoring processes when compared to participants who had lower motivation scores for either the extrinsic or intrinsic category. Additionally, participants who had high extrinsic and high intrinsic motivation significantly outperformed those who had low extrinsic and low intrinsic motivation.

Considering the general academic success, Emily (2011) investigated whether intrinsic and extrinsic motivation separately predicted students' performance. A significant positive relationship between intrinsic motivation and student performance was found, and there was a negative relationship between extrinsic-motivation and student performance (Kaufman, Agars, Lopez & Wagner, 2008). Watson, McSorely, Foxcraft, and Watson" (2004) studied the effects of both intrinsic and extrinsic motivation on a specific college final course grade. They found that higher levels of both motivation orientation variables positively correlated with higher course grades (Watson et al., 2004). Gambari (2016) found both intrinsic and extrinsic motivation positively predicted final course grades in organic chemistry.

In contrast, Yu in Gambari (2016) found that intrinsic motivation negatively predicted course performance in college chemistry. Glynn, Taasoobshirazi, and Brickman (2007) investigated the relationship between overall motivation to learn chemistry and chemistry performance. They reported that students found science courses relevant to their careers; both their motivation and science performance levels were higher. In another study, Glynn, Taasoobshirazi, and Brickman (2009) found that when college students reported lower motivation in science courses their performance was lower as well. However, students can be simultaneously intrinsically and extrinsically motivated (Kaufmann et al., 2008; Lin, McKeachie, & Kim, 2002; Watson et al., 2004).

However, an individual's goals are related to his or her reasons for engaging with tasks. Goals can be subdivided into mastery goals (which can be compared with intrinsic values) and performance goals (which can be compared with extrinsic motivation) (Broussard & Garrison, 2004). Mastery goals focus on learning for the sake of learning, whereas performance goals emphasize high achievement. Mastery goals are associated with high perceived ability, task analysis and planning, and the belief that effort improves one's ability. On the other hand, performance goals are associated with judgments about achieving, grades, or external rewards. An alternative framework for categorizing goals is to compare ego-involved goals (similar to performance goals) with task-involved goals (similar to mastery goals). Ego-involved goals focus on maximizing favorable impressions of competence. Those with ego-involved goals are preoccupied with questions like, Will I look smart? or Will I outperform others? Emily (2011) argues that students with ego-involved goals are more likely to select tasks they know they can complete.

In contrast, task-involved goals focus on task mastery and increased competence. Students with task-involved goals are preoccupied with the questions, how can I do this task? and What will I learn? Such students are more likely to choose challenging tasks. As Eccles and Wigfield (2002) observe, mastery goals are associated with the strongest empirical evidence to date and have been linked to self-competence, self-concept, effort attributions, increased persistence at difficult tasks, and use of cognitive strategies related to monitoring, problem-solving, deep processing of information, and self-regulation.

Similarly, Linnenbrink and Pintrich (2002) offer a model of the relationship between motivation and cognition that incorporates students' prior achievement, social aspects of the learning setting, motivational variables (e.g., expectancies and values), and cognitive variables (background knowledge, learning strategies, metacognition, and self-regulation). This model depicts motivation as both affecting and being affected by cognition, and both of these are, in turn, affected by social context. The model also portrays cognition and motivation as affecting academic engagement and achievement.

Motivation is also related to achievement and IQ. Research demonstrates a relatively consistent relationship between motivation and achievement in reading and science (Broussard & Garrison, 2004). Intrinsically motivated first-grade students tend to have higher achievement in these subjects than extrinsically motivated students, and mastery (or intrinsic) motivation predicts reading and science achievement, whereas judgment (or extrinsic) motivation does not. In third grade, both types of motivation predict reading achievement, whereas intrinsic motivation alone predicts science achievement. Moreover, the relationship between motivation and achievement appears to strengthen with age. By age 9, students with high levels of motivation consistently exhibit higher achievement and class grades than students with low motivation (Broussard & Garrison, 2004).

Similarly, Carpusa, et al (2007) report that intrinsically motivated students in third grade through fifth grade tend to have higher academic self-efficacy, exhibit higher levels of mastery behavior, and have higher reading and science achievement. Indeed, Lange and Adler found that motivation contributes to the prediction of achievement over and above the effects of ability. Typically, researchers have used such findings to support the conclusion that motivation leads to achievement. Gottfried, (2001) also found a relationship between motivation and achievement, but she maintains that the causal relationship works in the opposite direction. Similar to results from other studies, Gottfried found that elementary-age children with higher academic intrinsic motivation tend to have higher achievement and IQ, more positive perceptions of their academic competence, and lower academic anxiety.

However, in Gottfried's study, early achievement more strongly predicted later motivation than the reverse. Whereas motivation was mildly correlated with later achievement, the strongest correlations were between achievement at ages 7 and 8 and motivation at age 9, such that high achievement at an early age was associated with high motivation at a later age. Similarly, high IQ at ages 7 and 8 is predictive of high motivation at age 9. However, Gottfried speculates that motivation may be predictive of achievement in the longer-term through one of two possible mechanisms. First, motivation is strongly related to contemporaneous achievement, which is highly predictive of later achievement. Second, early motivation is predictive of later motivation, which is strongly related to contemporaneous achievement.

Motivation is related to a number of other academic factors, including several so-called 21st century skills identified as important in preparing students for college, the workforce, and lifelong learning. For example, motivation has been linked to critical thinking. Definitions of critical thinking vary widely, but common elements of most definitions include the following component skills:

i. analyzing arguments (Emily 2011),
ii. making inferences using inductive or deductive reasoning (Willingham, 2007),
iii. judging or evaluating (Case, 2005) and
iv. making decisions or solving problems (Willingham, 2007).

In addition to skills or abilities, critical thinking also entails dispositions. These dispositions, which can be seen as attitudes or habits of mind, include factors such as open- and fair-mindedness, a propensity to seek reason, inquisitiveness, a desire to be well-informed, flexibility, and respect for and willingness to entertain diverse viewpoints (Emily 2011). The disposition to think critically has been defined as the "consistent internal motivation to engage problems and make decisions by using critical thinking" (Facione, 2000). Thus, student motivation is viewed as a necessary precondition for the exercise of critical thinking skills and abilities. Similarly, Deci and Ryan (2008) notes that a person's propensity or disposition to demonstrate higher order thinking relates to his or her motivation.Halpern (2000) argues that effort and persistence are two of the principle dispositions that support critical thinking, and Emily (2011) maintains that perseverance is one of the "traits of mind" that render someone a critical thinker. Thus, motivation appears to be a supporting condition for critical thinking in that unmotivated individuals are unlikely to exhibit critical thought.

On the other hand, a few motivation researchers have suggested the causal link goes the other way. In particular, motivation research suggests that difficult or challenging tasks, particularly those emphasizing higher-order thinking skills, may be more motivating to students than easy tasks that can be solved through rote application of a predetermined algorithm (Emily 2011). Pintrich's framework holds that cognition and motivation affect one another that both affect academic achievement, and that both, in turn, are affected by the social context of learning (Linnenbrink & Pintrich, 2002; Pintrich, 2003).

Motivation is also related to metacognition, which is defined most simply as "thinking about thinking." Other definitions include the following:

i. "The knowledge and control children have over their own thinking and learning activities" (Emily, 2011).
ii. "Awareness of one's own thinking, awareness of the content of one's conceptions, an active monitoring of one's cognitive processes, an attempt to regulate one's cognitive processes in relationship to further learning, and an application of a set of heuristics as an effective device for helping people organize their methods of attack on problems in general" (Emily 2011).
iii. "The monitoring and control of thought" (Case, 2005).

Metacognition entails two components: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge includes knowledge about oneself as a learner and about the factors that might impact performance (declarative), knowledge about strategies (procedural), and knowledge about when and why to use strategies (conditional). Metacognitive regulation is the monitoring of one's cognition and includes planning activities, monitoring or awareness of comprehension and task performance, and evaluation of the efficacy of monitoring processes and strategies. Insights experienced while monitoring and regulating cognition play a role in the development and refinement of metacognitive knowledge.

In turn, cognitive knowledge appears to facilitate the ability to regulate cognition. The two are empirically related and may be integrated in the form of metacognitive theories, which are formal or informal frameworks for representing and organizing beliefs about knowledge.

In the context of metacognition, motivation is defined as "beliefs and attitudes that affect the use and development of cognitive and metacognitive skills" (Schraw, Crppen & Hartly, 2006). Metacognition entails the management of affective and motivational states, and metacognitive strategies can improve persistence at challenging tasks (Case 2005). As Emily (2011) observes, "because strategy use is effortful and time-consuming and because it requires active monitoring and evaluation, it is an indicator of students' cognitive engagement in literacy". Effortful control, which refers to the ability to monitor and regulate the impact of emotions and motivational states on one's performance, is one aspect of the executive functioning inherent in metacognition. (Eisenberg, 2010).

Conclusively, motivation refers to those reasons that underlie behavior that is characterized by willingness and volition. Intrinsic motivation is motivation that is animated by personal enjoyment, interest, or pleasure. Researchers often contrast intrinsic motivation with extrinsic motivation, which is motivation governed by reinforcement contingencies. Traditionally, educators consider intrinsic motivation to be more desirable and to result in better learning outcomes than extrinsic motivation. Motivation involves a constellation of closely related beliefs, perceptions, values, interests, and actions. For example, self-efficacy is an individual's perceived competence in a given area, and people tend to be more motivated to participate in activities at which they excel. A person's perceptions of control over their own successes and failures are known as attributions, with certain types of attributions more likely to stimulate motivation than others. In particular, attributing failure to lack of effort is more motivating than attributing failure to lack of ability, whereas the opposite is true for successful performance.

Inspite of the unprecedented effects of mastery learning instructional-strategy on science education in advance countries towards student’s motivation, it has not much head way in Nigeria. Little is known about the use of mastery learning instructional-strategy in Nigerian educational system particularly towards motivating students. Therefore much remain to be studied on the effects of mastery learning instructional-strategy towards motivation to learn to chemistry in Nigeria.

2.4.1 Students Motivation and Performance in Chemistry

Wachanga et al (2010) opined that mastery learning motivates students through increased interest and curiosity. Mastery learning can add variety to the regular classroom instruction program and they tend to be special and enjoyable learning experiences. As a result, students will develop positive attitude towards classroom activities. Increase student-student and student-teacher social interaction. Mastery learning provides an opportunity to involve students, parents teachers in the instructional program. Emily (2011), have defined motivation as reason for directing behaviour toward a particular goal, engaging in a certain activity, or increasing energy and effort to achieve the goal. Ayub, (2010) refers motivation as "the reason underlying behavior".

In the context of metacognition, motivation is defined as belief and attitudes that affects the use of development of cognitive and metacognitive skills (Chow & Yong, 2013). Matecognition entails that the management of effective and motivational state and metacognitive persistence challenging task (Martinez, 2006). Effortful control, which refers to the ability to monitor and to regulate the impact of emotion and motivational state on ones performance, is one aspect of executive functioning inherent in metacognition.

Motivation is a theoretical construct used to explain behavior. It represents the reasons for people's actions, desires, and needs. Motivation can also be defined as one's direction to behaviour and vice versa, (Deci et al, 2008). Similarly, Gambari, (2016) revealed that motivation is a significant variable in shaping the attitude of individual. Many researchers have suggested many strategies that would be used by the teacher to motivate the students to learn. It is a quality that students, teachers, parent, school administrators and other members of the community must have if our educational system is to prepare young people adequately for the challenges and demands of coming century. Hanock, (2004) contended that it is important for students to be motivated and well prepared for class units and activities in the school. Equally, students' motivation is said to be as important as any other variables in a learning situation. Their recommendations for teachers based on study results included the allowing students to have choice between equally challenging tasks, and minimizing external rewards as motivators for achievement.

The researcher suggested that motivated students are problem solver and academic achievers. He further maintained that motivation sustain students' interest in studies reduce the rate of dropout, truancy and low enrollment.

2.4.2 Mastery learning and Motivation in Chemistry

Learning activities and assessment task that call for critical thinking may in turn improve students motivation. Moreover motivation underlies the development and expression of metacognition. Motivation also becomes increasingly differentiated over time, both within and between school subjects.

Mastery Learning Approach (MLA) can help the teacher to know students area of weakness and correct it thus breaking the cycle of failure. Results from research studies carried out on Mastery Learning Approach (MLA) suggest that Mastery Learning Approach (MLA) yields better and transfer of material, yield greater interest and more positive motivation in various subjects than Non-Mastery Learning Approaches (Ngesa, 2002; Wachanga & Gamba, 2004 and Wambugu & Changeigwo, 2007). Furthermore, there is need to use method that will motivate students towards studying Chemistry so that the learners can perform and acquire knowledge and skills that will be relevant in future careers. Hancock (2004), asserts that a motivated learner performs well.

The teaching approach a teacher adopts is a strong factor that may affect the students' motivation towards learning, therefore affecting the performance. Motivation can be enhanced through teaching methods that actively involve students(Keraro, Wachanga & Orora, 2005). Students are categorized as academically motivated when they are able to maintain a high ability and are competent in their work. How the teachers view motivation will influence what they should do to establish a classroom environment that will enhance students' motivation

(Wachangaet al, 2010). A teacher has the ability to influence the students' motivation to learn through a variety of teaching decisions and approaches (Deci & Ryan, 2009). According to Wachanga et al, (2010), there is need for classroom practices that would arouse the students' motivation and attention, raise their expectancies of success in academic work and give them incentives and rewards that they value. A teaching method that would help student's to find satisfaction in the subject matter and also make the subject matter relevant to the needs of the leaner would be necessary to motivate them. It is important that a teacher adopts a teaching approach that will enhance the four dimension of motivation, namely Attention, Relevance, Confidence and Satisfaction (ARCS) to learn academic subject matter. There are two types of motivation to learn: These are extrinsic and intrinsic motivation. Extrinsic motivation is directed at earning rewards that are external to a learner, while intrinsic motivation is doing something because it is inherently interesting or enjoyable (Deci & Ryan, 2000).

Most of the tasks found in chemistry course that a student is required to perform are not inherently interesting or enjoyable. There is need for a teaching strategy that will promote more active and volitional form of extrinsic motivation (Deci & Ryan, 2000). Several early studies have showed that positive performance feedback enhanced intrinsic motivation (Wachanga et al 2010); therefore, a teaching approach that has continuous feedback to the performance of student can motivate students to value and self-regulate the academic activities, carrying them out on their own. According to self- determination theory, this can be done by fostering internalization and integration of values and behavioural regulation (Deci & Ryan, 2009). Internalization is the process of taking in a value or regulation and integration is the process by which individual more fully transform the regulation into their own so that it will emanate from their sense of self (Deci & Ryan, 2000).

Students' mastery of contents can allow internalization and integration of regulations or values in a subject area and also allows them to work autonomously but in a self-regulated manner (Deci & Ryan, 2008). Mastery learning approach (MLA) emphasizes students' mastery of specific learning objectives and uses corrective instruction to achieve that goal (Wachanga et al 2010). MLA works particularly well with hierarchically and sequentially ordered subjects. MLA assumes that virtually all students can learn what is taught in school if their instruction is approached systematically and students are helped when and where they have learning difficulties (Wachanga et al 2010). The most important feature of MLA is that it accommodates the natural diversity with any group of students, according to their levels of understanding. The goal of MLA is success for the student, in achievement and motivation. MLA tends to enhance student's cognitive and affective perspective for learning task and can build more motivation towards learning Chemistry. This allows for relatedness in that the students feel respected and cared for by the teachers. Also through feedback, the students will more likely adopt and internalize the objectives since they understand it and have the relevant skills to succeed at it.

Evidence documents see motivation as an important determinant predicting students' performance (Baal & Stevens, 2007; Broussard & Garrsion, 2004; Sandra, 2002; Skaalvik &Skaalvik, 2006; Zhu & Leung, 2011). Motivation, like other attitudinal behaviors, encompasses many aspects and one such aspect is motivational orientations. According to Johnson (2007), motivational orientations act as a driving force that encourages a person to engage in a task. Motivational orientations consist of several constructs and among these are intrinsic motivation, extrinsic motivation, personal relevance, self-efficacy, self-determination, and assessment anxiety. Intrinsic motivation is an inner force that motivates students to engage in academic activities, because they are motivated in learning and they enjoy the learning process as well (Chow & Young 2013).

Chow et al (2013) explained that intrinsic motivation is the true drive in human nature, which drives individuals to search for and to face new challenges. Their abilities are put to the test and they are eager to learn even when there are no external rewards to be won. Students with learning goals of seeking understanding for mastery of science content and skills are said to be intrinsically motivated (Cavallo, Rozman, Blinkenstaff, & Walker, 2003). Chow et al (2013) stated that intrinsically motivated individuals possess the following characteristics: They engage in both mental and physical activities holistically, they remain highly focused throughout these activities with clearly defined goals, they are self-critical, they self-reflect on their own actions realistically, and they are usually relaxed and not afraid to fail during learning. A research study done by Chow et al (2013) concluded that, intrinsically motivated students learn independently and always choose to do challenging tasks. They persevere to complete the tasks they have undertaken. They integrate their knowledge acquired in school with their experiences gained from outside school. They often ask questions to broaden their knowledge and learn regardless of any external push factors or help from teachers, and they take pride in their work and express positive emotions during the learning process. Highly intrinsically motivated students are able to learn new concepts successfully and show better mastery of the subject matter (Chow et al 2013).

Unlike intrinsic motivation, extrinsic motivation drives students to engage in academic tasks for external reasons. Extrinsic motivators include parental expectations, expectations of other trusted role models, earning potential to enroll in a course later and good grades. According to Benabou and Tirole (2003), extrinsic motivation promotes effort and performance with rewards serving as positive reinforces for the desired behavior. Extrinsic motivation typically produces immediate results and requires less effort in comparison to intrinsic motivation (Ryan & Deci, 2000). The down side of it is that extrinsic motivators can often distract students from true independent learning. Another problem with extrinsic motivators is that they typically do not work over the long term. Once, the rewards are removed, students lose their motivation (DeLong & Winter, 2002). As extrinsically motivated, students tend to focus on earning higher grades and obtaining rewards, Chow et al, (2013) believed that extrinsic motivational factors can diminish students' intrinsic motivation. Such observation has also been reported by Bain (2004) who concluded that extrinsic rewards have negative impacts on intrinsic motivation. However, both intrinsic and extrinsic motivation enhances the students' mastery of the subject contents.

Studies which specifically investigated students' ability have yielded interesting findings in relation to their motivation. Talib, Wong, Azhar, and Abdullah (2009) conducted an in-depth study on motivation of students with outstanding performance in academics and revealed that good science learning outcomes do not rely on the way teaching is carried out but on many factors which include students' ability. Feldhusen and Hoover in Chow et al (2013) identified self-concept and motivation as the most important factors for high ability students' academic performance. Other studies report that high ability students have higher scores than low ability students on academic goals, valuing science, and perceived ability and they have more positive attitudes toward science in terms of interest and career in science than low ability students (Debacker & Nelson, 2000). According to Busato, Prins, Elshout, and Hamaker (2000), intellectual ability and achievement motivation were positively associated with academic success. Other reasons for the high academic success of high ability students are their high level of motivation to continue their education (Kozochkina, 2009), their high intellectual ability, verbal ability, attribution of failure to stable factors and mood, academic self-concepts, attainment value, rehearsal, time management, and effort management than low ability students (Lau & Chan, 2001).

2.5 Gender-Related Differences in Learning Chemistry

Gender-related issues have attracted attention of many researchers in chemistry education with a view to improving chemistry instructions for boys and girls in secondary schools.

Gender, according to Okeke (2008), is the social or cultural characteristics, roles or behaviour which males and females are known for by society. Onyegegebu (2008) referred to gender as the sum total of cultural values, attitudes, roles practices and characteristics based on sex. Onyegegebu further described sex as the innate biological differences between women and men. So both women and men differ by their physiology. Okeke (2008) described the men as bold, tactful, intelligent, aggressiveand so on and the women as dull, passive, submissive, talkativeand so on. These attributes affect their performance in chemistry, because factors such as sex-role stereotyping, female socialization process, masculine images in chemistry textbooks exhaust could contribute to the observed differences in performance of boys and girls. The difference could also be attributed to what Nnaka (2008) reported that girls do not get encouragement in science classes from the teachers, rather they make negative comments to girls about kind of work/course girls should undertake.

Although some researchers, Mari (2012) reported that girls did betters than boys in students' conceptual understanding of force and motion. Nnaka (2008) showed that girls had greater influence on their attitude towards chemistry than boys. On the other hand, Madu (2004), Iweka (2006), Obiekwe (2008), Agomaoh (2010) and Ukozor (2011) reported that boys performed better than girls in sciences. Other researchers, Okeke (2007), Viko (2002) and Omoniyi, (2006), showed that gender has insignificant effect on science performance. Okoro (2011), opined that instructional method used in the classroom may influence gender and students' academic performance in science. Okoro also further supported the argument that females performed better than males when co-operative learning strategy is used. On the other hand, when competitive or individualized learning strategy is used males did better than females.

However, there has been contrasting opinions on gender related issues in interaction. Onyegegbu (2004) in his research reported that girls participated in fewer interactions than boys. Fatokun and Odagboyi (2010) viewed gender as a significant factor in students' performance in chemistry due to interaction patterns, Fatoba and Aladejana (2014) stated that gender was found to have no effect on students' attitude to learning while Olasheinde and Olatoye (2014) findings showed that there was no significant difference between male and female students in overall science performance in Katsina State. In most science-related fields there tend to be more males than females as Baker and Macilyntyre (2003) carried out experiment at Georgia Elementary Schools and concluded that both boys and girls showed significant difference in science and other subjects between the ages of 13 to 14 years when they were younger and that as they grew, their motivation reduced.

Furthermore, gender consideration in the learning of Chemistry is very important because gender disparity has not only been observed in the daily life matters but also in academic performances. While the males are accorded the responsibility of dealing with complex and difficult tasks of life matters inside and outside the house, the girls are to hand the relatively easy and less demanding tasks. Hausmann, Tyson and Zahidi (2009) reported that there is no country in the world that has yet reached equality between women and men in different critical areas. According to Kwaileh and Zaza (2011), studying the gender differences is important because it influences the society's views about the roles of females in the society, females' self-confidence and ambitions, and the effect of stereotyping in education.

Owuamanan and Babatunde (2007) noted that the girls tend to go for courses that do not require more energy and brain tasking such as home making while the boys look for jobs in management, engineering, banking and other brain tasking professions. This contention is supported by a study carried out by Tim, (2014) on Nigerian Physics student population. In the study, it was determined that the interaction of sex-role stereotyped expectations and performance were significant and that the lower expectations of the female students correlated with lower performance. Abosede (2010), opined that a probable reason for inequality in sex selection in some sex dominated subjects could be adduced to more cultural and social orientation from parents and the entire society. Salami (2013), stated that what differentiates men and women are their ethical and behavioural approaches to their academic pursuits, social environment and traditional gender ideology. Alao and Abubakar (2010) opined that gender roles affect familiarity with academic content, career aspirations, attitude towards subjects, teacher’s expectation and preferred approaches and these in turn affect academic performance.

Similarly studies carried out byMari, (2012) attributed the sex difference in performance to teachers who according to him spoke more frequently to boys, asked the boys higher order questions and praise them for quality work and girls for neatness. Mari (2012) noted that male students received more praises and criticisms from the teachers than the female students. Boys domination of practical activities that are known to enhance acquisition of science and reasoning skills in the class is considered as one of the major reasons for the difference in reasoning ability between boys and girl. Boys are known to have higher self-efficacy for learning science than girls and this tend to give them more confidence and greater influence over girls in designing and conduct of laboratories activities. Thus, the prevalent circumstances in the classrooms predispose boys to take charge or dominate science activities whenever they are paired to work with girls.

Another reason advanced for the sex differences in science reasoning was advanced by Mari (2001), who attributed gender related differences to reasoning skill. Many studies, Mari (2012), and Mari, (2001) demonstrated that boys are superior to girls in their level of performing Piagetian like formal reasoning tasks. Individuals who perform Piagetian tasks are said to have acquire formal reasoning which is defined as the ability to construct concepts by engaging abstract or hypothetico-deductive reasoning skills like proportional reasoning, controlling variables, probability reasoning, correlational reasoning and combinational reasoning. Piaget observed that at formal operational stage we have acquired abstract, logico-mathematical reasoning capacities that allow us detach ourselves from the object world so that we can reason about it in strictly logical terms.

Moreover, studies have also shown that motivational orientations are discipline-based depending on the subjects that the students have opted for their studies. Chow et al (2013),found that girls' motivational orientations toward biology and chemistry were more positive than boys, whereas boys have more positive orientations toward physical and general science. Girls' higher motivational orientations toward biological sciences were also reported by DeBacker and Nelson (2000).Moreover, gender differences in the effectiveness of cooperative learning strategies have also been researched by various scholars (Collazos, 2002). Garduna, (2001), investigated gender differences in cooperative problem solving in gifted students. She found no statistically significant difference in studentsperformance or self-efficacy in single or mixed gender groups. Viann, (2004), found no significant gender related differences, but females performed slightly higher grades than males. However, other researchers believe that males thrive better in a competitive environment while females excel in a cooperative classroom setting (Hall, 2008, Halpern 2000). Kolawole, (2007) found that boys performed better than girls in both cooperative and competitive learning strategies when he investigated the effect of cooperative and competitive learning strategies on Nigerian students' academic performance in Mathematics.

Apart from general gender differences, researchers also disagree as to which type of gender pairs work most productively. One study claims homogeneous pairs consisting of either males or females work best (Adesoji 2015). Another study claims that heterogeneous pairs (males and females) work most effectively (Adesoji 2015). Some found male pairs to be more effective than female pairs (Adesoji 2015).

Furthermore, previous investigations on the effect of gender on students'performance in Chemistry showed that males often outperform their female counterparts (Adesoji 2015). Very few research studies showed that female studentsare superior or comparable to males (Cousin 2015).Similarly,mixed results have been revealed regarding the gender differences in science performance. Science is meant to include physics, chemistry, biology or a composite of any areas of scientific knowledge. In the comparison study of 2011 Trends in International Mathematics and Science Study (TIMSS), Amelink (2009) reported that American male and female fourth-graders did not show a significant difference in their science performances, but male eighth-graders represented significantly better performances than female counterparts overall in science (that is physics, biology & earth science) except chemistry. This phenomenon has been consistent based on the American data of the National Assessment of Educational Progress (NAEP) from 1969 to 1999 which found that males in the primary and middle schools outperformed females on science achievement tests, and the data of1999 TIMSS which indicated that males outperformed females significantly in science tests.

In addition, the result from Advanced Placement Program (APP) for American high school students in 2007 confirmed that male students scored higher on 35 tests including chemistry test than female students. The percentage of male students receiving a score of 5 (that is, extremely well qualified) in APP chemistry test participants is 18% while the one of female students is 11%. This phenomenon seemed to be extended to the American higher institutions. Nwoye (2012) reported that there was a significant difference in the final chemistry grades between university males and females. Male students scored better than female students. However, the cross-cultural evaluation of science achievement conducted by International Evaluation of Education Achievement (IEA) also pointed out the same trend of lower female achievement compared with male students. The First and Second International Science Study (FISS & SISS), and Third International Mathematics and Science Study (TIMSS) revealed that there has been consistent outperforming of male students in the written achievement tests of every science subject (Amunga, Amadalo, & Musera, 2011). They also found out that, male students outperformed female students in chemistry in 32 secondary schools in Western Province of Kenya. The chemistry results of male students had the upper hand from the year of 2005 until 2009 compared with female students. Likewise, Male students' higher performances in chemistry have also been seen in other countries such as Nigeria and Kenya.

Theresa (2013), investigated the effects of gender and location on students' chemistry performance in a local government area in Nigeria. The findings showed that chemistry performance of male students was significantly higher than the one of female students in both rural and urban areas. The same phenomenon was found in an Ethiopian college in which Nzekwe (2013) ,investigated the gender difference of 100 students in terms of chemistry performance. The finding showed that male students are better performers than female in chemistry.

It is noteworthy, however, that there have been the other line of research which indicated no significant difference between genders in science performance. Take Oludipe's (2010) study for instance. It reported that there was no significant difference in basic science performance between male and female junior secondary school students in Nigeria. Given that there were some other studies reporting the disadvantaged position and low motivation of male students in science subjects (Omoniyi, 2006).Eventual performanceby learners seem to be closely related to personal efforts, cognitive abilities, and pedagogical practices than gender variable (Hong, 2015).

There are many researches that revealed gender differences in Self-Regulated Learning (SRL). Al-Khatib's (2010), study involving 404 United Arab Emirates (UAE) college students indicated that the UAE female college students displayed significantly higher means of test anxiety, self-efficacy and self-regulated learning than the male counterparts. Even though these female students revealed higher level of test anxiety, they performed better than the male students probably because they enjoyed learning more and made more efforts than the male students due to their strong motivation to pursue college education.

DiBenedetto and Bembenutty (2011), also found that female students show higher self-regulation ability than male students in a college biology course in New York. Bidjerano (2005),also found that American female college students outperformed male students in terms of their use of rehearsal, organization, metacognition, time management skills, elaboration, and effort. This result is keeping in line with previous studies representing the better performance of female students in terms of strategy use (Hong, 2015). Female students do not only tend to be more willing to participate in the report of their strategy use compared to male students, but they seem to be more reflective on their learning experiences and their strategy use, due to the innate nature of their gender disposition. Even primary and secondary school female students demonstrated the same distinguishing features of self-regulated learningthat isthe girls tend to make much more use of self-monitoring, goal setting, planning and structuring of their study environment than boys among 14 self-regulatory learning strategies (Zimmerman & Martinez-Pons in Hong, 2015).

According to Green (2006) there is evidence that girls are less likely than boys to have equal access to activities and materials in educational settings, most especially in mixed sex contexts. Green and Rechis (2003) concluded that boys tend to dominate learning resources in mixed sex group. The dominance of boys has been largely attributed to their ability to compete more than the girls (Vugt, 2007). Girls have been observed to play in smaller groups and to engage in more intimate social interactions, turn taking, and cooperative endeavours, Green (2006). Competitive interaction among boys unlike the communal or cooperative interaction among girls usually inhibits learning when paired homogeneously. However, the communal interaction of girls facilitates learning when they are paired homogenously. The heterogeneous gender pair is a blend of competition and cooperation. Therefore, the pendulum of effectiveness of learning in such pairings may be beneficial to or detrimental to either males or females. Hence there is need for the teachers to employ mastery learning instructional strategy in order to increase classroom communication during chemistry lesson thereby increasing the performance and motivation in the subject.

2.6 Overview of Similar Studies

Study investigated by Wachanga,Changeiywo and Wambagu,(2010) on the effects of using Mastery Learning Approach (MLA) on Secondary School Students' Motivation to learn Physics, Solomon four Non-Equivalent Control Group Design under the Quasi-experimental research method was used in which a random sample of 4 co-educational secondary schools were obtained in Kieni East Division of Nyeri District in Kenya. The 4 schools were randomly put into 4 groups. Each school provided 1 Form Two class for the study; hence, a total of 161 students were involved. The students were taught the same physics content. In the experimental groups, MLA teaching method was used while the regular teaching method was used in the control groups. The researchers trained the teachers in the experimental groups on the technique of MLA before the treatment. Two groups were pre-tested prior to the implementation of the MLA treatment. At the end of treatment period, all the 4 groups were post-tested using a validated Students' Motivation Questionnaire, whose reliability coefficient was 0.76. Data were analysed using the test, analysis of variance and analysis of covariance. The results of the study show that students exposed to

MLA have significantly higher motivation than those taught through regular methods. Gender has no significant influence on their motivation to learn physics. The researchers conclude that MLA is an effective teaching method in motivating students; hence, physics teachers should incorporate it in teaching.

Pepple (2014) examined the effect of mastery learning on secondary school achievement, in chemistry. The study adopted a quasi experimental design. A fifty (50) item multiple choice option of chemistry Achievement test constructed from chemical strometer, mole concept, electrolysis, acid, base and salt) was used for the collection of protest posttest scores. A 2x2x2 factorial design was used. The analysis of covariance ANCOVA was used in testing significance and validity of different variables used in the hypothesis. The Statistical Package for the Social Sciences (SPSDS) was used for data analysis, to enhance accuracy of the result obtained. The results show that the mean difference in academic achievement between the two teaching approaches was in favour of the experimental group was very minimal ($F_{(1.157}$=83,378, p=0.000), It also indicates that the mean difference in achievement between the male and female between the urban and rural students of the experimental group is very minimal ($F_{(1, 77}$=1.233, p=2.70). It revered that the mean difference in achievement between the male and the female urban students of the experimental group was very minimal ($F_{(I, 37}$=.871, p=357). It indicates that the mean difference in academic achievement between the male and the female rural students of the experimental group is very minimal F1, = 1.667, P = .205). The experimental group (mastery learning) performed significantly better than the control group (conventional teaching method); government should motivate teachers by ensuring good conditions of service, considering that mastery learning strategy demand absolute dedication on the part of teachers, the schools should allow more flexibility in the time assigned to teach a unit of subject in order to attain mastery.

Wachanga and Johnson, (2008) carried out a research on the effects of Mastery Learning Approach (MLA) on Students' Achievement in Physics. The study was Quasi-experimental and Solomon Four Non-equivalent Control Group Design was used. The target population comprised of secondary school students in Kieni East Division of Nyeri District. The accessible population was Form Two students in district co-educational schools in the division. Purposive sampling was used to obtain a sample of four co-educational secondary schools. Each school provided one Form Two classes for the study hence a total of 161 students was involved. The students were taught the same Physics topic of Equilibrium and Centre of Gravity. In the experimental groups MLA teaching method was used while theRegular Teaching Method (RTM) was used in the control groups. The experimental groups were exposed to MLA for a period of three weeks. The researchers trained the teachers in the experimental groups on the technique of MLA before the treatment. Pretest was administered before treatment and a post-test after three weeks treatment. The instrument used in the study was Physics Achievement Test (PAT) to measure students' achievement. The instrument was pilot tested to ascertain the reliability. The reliability coefficient α was 0.76. Experts ascertained their validity before being used for data collection. Data was analysed using t-test, ANOVA and ANCOVA. Hypotheses were accepted or rejected at significant level of 0.05. The results of the study show that MLAteaching method resulted in higher achievement but gender had no significant influence on their achievement. The researchers concludes that MLA is an effective teaching method, which physics teachers should be encouraged to use and should be implemented in all teacher education programmes in Kenya. The finding of this study is of relevance to the present study in that it will be a guide to the researcher to investigate the effect of mastery learning instructional strategy on senior secondary school chemistry students in Karaye education zone Kano, Nigeria.

Tim (2014), conducted a research on the effects of Mastery Learning Approach (MLA) on students' Achievement in Integrated Science. The study was Quasi-experimental Nonrandomized Pretest-Posttest Control Group Design. The target population comprised of Junior Secondary School Students (JSS) in Delta Central Senatorial District of Delta State, Nigeria. The accessible population was JSS III Students drawn from the district co-educational schools in the Senatorial District. Purposive sampling technique was used to obtain a sample of four coeducational secondary schools. Each school provided one JS III class for the study, hence a total of 120 students were involved. The students were taught the same Integrated Science topic of Drug Abuse and Metabolism in the Human body. In the experimental group MLA teaching method was used while the conventional method was used in the control group. The experimental group was exposed to MLA for a period of four weeks. The researcher trained the teachers in the experimental group on the technique of MLA before the treatment. Pretest was administered before treatment and a posttest after four weeks of treatment. The instrument used in the study was Integrated Science Achievement Test (ISAT) to measure students' achievement. The instrument was pilot tested to ascertain the reliability. The reliability co-efficient alpha was 0.74. Data was analyzed using ANCOVA statistics. Hypothesis was accepted or rejected at 0.05 significant level. The result of the study show that MLA teaching method resulted in higher achievement. The researcher concluded that MLA is an effective teaching method, which Integrated Science teachers should be encouraged to use and should be implemented in all teachers' education programmes in Nigeria and other African nations.

Furthermore, John, Barchok & Ngeno (2014), investigated the effects of Cooperative Mastery Learning Approach (CMLA) on Students' Motivation by Gender in Chemistry in Kenya's Bomet Country. Non-equivalent Control Group Design under Quasi experimentalResearch was used in which samples of four co-educational district secondary schools were drawnfrom the schools in the County. Each school provided one Form Two class for the study. This translated to a totalof 205 Form Two chemistry students. Students in all the four groups were taught the same chemistry content ofthe topic, Effect of Electric Current on Substances. In the experimental groups, CMLA teaching strategy wasused while Conventional Teaching Methods were used in the control groups. Data was collected using Students'Motivation Questionnaire (SMQ) whose reliability coefficient was 0.82, hence suitable since it was above the0.70 threshold. A t-test and one-way ANOVA statistical techniques were used to analyse the data. The StatisticalPackage for Social Sciences (SPSS) was used in data analysis. All statistical tests were subjected to a test ofsignificance at 0.05 α-level. The findings indicate that after treatment, the level of motivation for both male andfemale students went up. However, there was no significant gender difference in motivation to learn chemistry.

Since the level of motivation was high for boys and girls taught using CMLA compared to those taught usingconventional teaching methods, it implies that the teaching approach is suitable for teaching both male andfemale students. CMLA enhances students' motivation to learn chemistry, therefore educators and teachersshould be encouraged to use it in an attempt to improve performance in chemistry as well as bridge the gendergap that exists between boys and girls in the learning of science. In addition, teacher education institutionsshould make it part of their teacher training curriculum content.

Georgina et al (2015), investigated the Effect of Mastery Learning on Senior Secondary School Students' Cognitive Learning Outcome in Quantitative Chemistry. Quasi-Experimental Control Group Design was used for the Study. Four Secondary Schools were randomly selected and randomly assigned to experimental and control groups. A total of four hundred and one (401) chemistry students were used for the study. Data was collected using a 25- item chemistry achievement test (CAT) drawn from stoichiometry and mole concept. The instrument was pilot tested and Kuder Richardson formula 21 (KR21) was used to establish the reliability coefficient (r = 0.7). Pretest was administered to both the experimental and control groups to ascertain if the two groups were comparable and have the same entry characteristics before the treatment. A post-test was administered to both groups after two weeks of exposing the experimental group to mastery learning and the control group to conventional teaching method. Data were analyzed using independent sample T-test. The mastery learning group had a higher mean score (x = 78.2; s = 9.90) than the control group (x - 58.4; s - 16.0 7). The difference was highly significant (t_{399}- 14.92; p = 0.00). About sixty nine percent (69%) of the students in the mastery learning group scored 80% and above, a score attainable by only 17.5% of the students in the control group. Similarly, about half (50%) of the students receiving conventional instruction scored between 40% and 49% whereas less than 1% of the students in the mastery learning group were in this group. The effect size was substantial (0.6). The researcher concluded that mastery learning is a very effective method of teaching and better than the conventional teaching method and recommended that chemistry teachers should be encouraged to adopt it in order to enhance the cognitive learning outcome of students in quantitative chemistry. The finding of this study is relevance to guide the present study in briding the gap that exist between male and female students in learning of chemistry using different concepts, hence mastery learning instructional strategy can be to enhance students performance in Nigeria schools.

In the same vein, Olorundare et al (2015), conducted a research to determine the Effects of Mastery Learning Instructional Strategy on Secondary School Students' Achievement in Mole Concept, a topic that has been empirically identified as contributing, to their poor performance of candidates in School Certificate Chemistry. The study used a Quasi-experimental Design and followed the Non-randomized, Non-equivalent pre-test and post-test Group design. Data were obtained from two intact classes in two purposively selected secondary schools in Ilorin South Local Government Area of Kwara State, Nigeria. The experimental group was taught the mole concept using mastery learning instructional strategy while the control group was taught using the conventional teaching method. The data obtained were analyzed using t-test and Analysis of Covariance (ANCOVA) with the pre-test and post-test scores as covariates. It was found that students taught using the mastery learning instructional strategy performed better (mean score 15.50) than their counterparts in the control group (mean score 7.04). Furthermore, gender had no significant effect on the achievement of the students taught using the mastery learning instructional strategy. Results also showed a statistically significant covariance between scoring level and group. Based on the findings of this study, it is recommended that teachers should consider using mastery learning instructional strategy for chemistry instruction to improve the performance of their students in chemistry examinations.

Gbara (2013) examine the effects of mastery learning strategy on senior secondary school students' performance in Mathematics in the Federal Capital

Territory Abuja. The sample size was 85 Students from population of 38, *725* SS II students. The sample was divided in to two groups, the experimental group, 45 students and control group, 40 students. The research adopted the pre-test, post test and postpost test experimental and control group design. A pretest was administered before the treatment to establish group equivalence. The sample in the experimental group were then exposed to the treatment using mastering learning strategy to teach number bases, indices and theory of logarithm. Two instruments were developed and validated for data collection. They were Test of Basic Mathematics Skill (TBMS) and Students Mathematics Achievement Test (SMAT). Three (3) Null Hypotheses were tested. The data collected were subjected to inferential statistics using t-test. The major findings from the study were that 1. The use of mastery learning strategy enhanced the performance of students in secondary school Mathematics. 2. Mastery learning strategy improves students' retention ability of some mathematics concepts. 3. Students gender not a significant factor in determining the performance of students in mathematics. Recommendations were made, some of these were as follows: the government should make qualitative and mastery learning instruction compulsory and make teachers to be aware and also the class size should be between 35 - 40 students to enhance effectiveness in mathematics performance. The teachers should be more committed to demonstrate the strategy.

These studies has given the present researcher an insight on selection of instruments to be used and also guided him on the number of consideration in conducting this research through the findings. Therefore the purpose of this study was to examine the effect of mastery learning strategy as an instructional programme to enhance chemistry achievement and motivation in karaye education zone kano state in Nigeria.

2.7 Implication of the Literature Review for the Present Studies

The literatures reviewed clearly explain the effects of mastery learning strategy as an instructional strategy that enhances teaching of science and arts.It also highlighted many studies carried out by several researchers suchas Pepple (2014), on the effects of mastery learning on secondary school achievement in Chemistry classroom that discovered students found mastery learning strategy to be interesting because it was engaging and offered improvement their academic perforformance. Wachanga et al (2010), examime the effects of mastery learning strategy on the academic performance and motivatition on Senior Secondary School Physics, their results showed better performance and motivation on the students taught with mastery learning strategy than those taught with lecture method. Olufunmilayo,(2010) Guskey(2010), Patricia and Johnson(2008), Kazu, Kazu and Ozedemi(2005), Adeyemi(2007), Wachanga and Gamba(2004), Georgina et al (2015) and Gbara(2013), carried out a similar research to investigate the effects of mastery learning strategy in arts and/or science lesson to measure students performance in those areas as measured by student scores on state achievement tests. Their results showed slightly higher score of those were tauht using mastery learning strategy than those taught using lectured method. However other studies carried out related to this study proved that a student learns better when taught using mastery learning instructional strategy this was reaffirm by Olorundare, Oyelekan and Lamidi (2015) that mastery learning strategy is more influential in teaching chemistry and science in general. Mastery learning is a strategy which is capable of bringing about progressive performance and motivation in learning chemistry. The previous reseaches on effects of mastery learning strategy on senior secondary school chemistry sudents motivation and academic performance yielded mix results. From the literature cited, most of the studies carried used different study areas not from Nigeria. Therefore, the present study is conceived to fill this gap. This research therefore used a new location, single sex-schools and using mole concepts for better results on the effects of mastery learning-instructional strategy on senior secondary school chemistry students motivation and academic performance in Karaye Education Zone Kano State Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The aim of this study was to investigate the effects of mastery learning instructional-strategy on senior secondary school chemistry students' motivation and academic performance. This chapter presents the methodology of the study under the following sub-headings.

3.2 Research Design

3.3 Population of the Study

3.4 Sample of the Study

3.5 Research Instruments

3.6 Validity of the Instruments

3.6.1 Pilot Testing

3.6.2 Reliability of the Instruments

3.6.3 Item Analysis

3.7 Administration of the Treatment

3.8 Procedure for Data Collection

3.9 Procedure for Data Analysis

3.2 Research Design

The research was carried out in schools with classes existing as intact groups. These could not be reconstituted for research purposes.

This study adopted pretest, posttest-quasi experimental control group design as proposed by Aikanhead (2005). The subject was pretested to dertermine the academic equivalence of the two groups in their ability level. The Experiemental Group (EG) was taught using Mastery Learning Instructional Strategy (X_1) while the Control

Group (CG) was taught using lecture method. After the treatment, posttest was administered to the subsets in the groups to determine the effects of the use of mastery learning instructional strategy compared to lecture method employed in teaching of these chemsistry concepts. The two groups weretaught the selected chemistry topics for a period of six weeks. The posttest was administered to the groups in order to determine the effect of mastery learning instructina strategy on chemistry student's motivation and academic performance in Karaye Education Zone Kano State. The design of the study is illustrated in figure2:

$EG \longrightarrow O_1 \longrightarrow X_1 \longrightarrow O_2$

$CG \longrightarrow O_2 \longrightarrow X_0 \longrightarrow O_2$

Figure 2: Research Design

Key:

EG = Experimental Group (those tauight using mastery learning instruction)

CG = Control Group (those taught using lecture method)

O_1 = Pretest (Test given before the treatment)

O_2 = Posttest (Test given after the treatment)

X_1 = Mastery learning treatment

X_0= Lecture method.

3.3 Population of the Study

The target population for this study covered all public senior secondary schools (SS II) students' own-by Kano State Government in Keraye Education Zone. There are public senior secondary schools with population of 3,590 Senior Secondary II Chemistry students in the study area. From this figure 2,741 were males while 849 were females with average chronological age of 16 years. The sample was consisted of four schools with a total number of one hundred and sixty one students (161) out of thirty eight schools of the population. The four sample schools were all single sex and located at rural areas not within the Kano State metropolis. The schools were operating as day and boarding schools. Detail of the population is presented in Table 3.1.

Table 3.1: Population of the study

S/NO	School Name	Male	Female	Total
1	G.S.S. KARAYE	369	-	369
2	G.S.S. CHEDI	120	-	120
3	G.S.I.S. KARAYE	65	-	65
4	S.I.S. KARAYE	90	-	90
5	G.S.S. YAMMEDI	54	-	54
6	G.S.S. T/KAYA	61	-	61
7	G.D.S.S. R/RUMA	165	-	165
8	G.S.S. ROGO	120	-	120
9	G.S.S. ZAREWA	120	-	120
10	G.S.S. YANOKO	42	-	42
11	G.S.S. FULATAN	78	-	78
12	G.S.S. BARI	86	-	86
13	G.S.S. BELI	48	-	48
14	G.S.S FALGORE	35	-	35
15	G.S.I.S. ROGO	83	-	83
16	G.S.S. K/MAIYAKI	330	-	330
17	S.I.S. K/MAIYAKI	53	-	53
18	G.T.Q.S. KIRU	323	-	323
19	G.S.S. DANGORO	90	-	90
20	G.S.S. YAKO	102	-	102
21	G.S.S. GALADIMAWA	30	-	30
22	G.S.S. BADAFI	40	-	40
23	G.A.S.S. KIRU	100	-	100
24	G.S.S. KIRU YAMMA	120	-	120
25	G.S.S. SAKARMA	17	-	17
26	G.G.S.S. KIRU	-	85	85
27	G.G.S.I.S. ROGO	-	54	54
28	G.G.S.S. FALGORE	-	13	13
29	G.G.S.S. ROGO	-	75	75
30	G.G.A.S.S. ZAREWA	-	119	119
31	G.G.S. GWAN-GWAN	-	83	83
32	G.G.S.S. DANGORA	-	53	53
33	G.G.A.S.S. YAKO	-	75	75
34	G.C.E. WOMEN K/MAIYAKI	-	40	40
35	G.G.A.S.S. K/MAIYAKI	-	35	35
36	G.G.S.C. KARAYE	-	44	44
37	G.G.S.S. KARAYE	-	103	103
38	G.G.S.I.S. K/FADA	-	70	70
	TOTAL	**2,741**	**849**	**3,590**

Source: Karaye Zonal Education Office,(2016)

3.4 Sample of the Study

A stratified random sampling was used. Four single sex schools were drawn from thirty eight secondary schools population. The unit of sampling was a secondary scools rather than indidual learners, because secondary schools operate as intactclasses(Borge& Gall 1989). Only single sex schools were sampled for the study, (see Table 3.2). This was done to avoid excessive stratification that results in complexities that stem from logistics involved in handling many schools in quasi experimental design. To ensure the schools selected are far apart from each other, two experimental and two control schools were randomly selected from each sub-counties usingrandom sampling where the selection of numbers at random used by using table of random numbers. This is to ensure that each school has an equal chance to be selected.

In like manner 45, 35, 44, and 37 students in each category and 161 students in all were selected. These figures are in line with Tuckman (1975), Sambo (2008) and Fraenkel and Wallen (2000) who recommend that a minimum sample size of 30% is reasonable figure in arriving at the total number of the subjects to participate in a research study. Hence the 161 students and four schools drawn from the population of 3,590 and 38 schools respectively is in agreement with this school of thought. The average age of the students was found to be 16 years. For the purpose of this studyan intact classes was usedcomparising of a total number of 161 number of SSII chemistry students to ensure that regular class period is not altered. Each of these schools have only one science class in each year group. Two schools were assigned as experimental groups and the other two schools served as control groups.(see Table3.2a).

Table 3.2: Sample for the Study

School	Group	Male	Female	Total
G.S.S KARAYE	Experimental	45	-	45
G.S.S ZAREWA	Control	35	-	35
G.G.S.S KARAYE	Experimental	-	44	44
G.G.S.C KARAYE	Control	-	37	37
	Total			**161**

Researcher's Field Survey (2016)

Therefore, the sample size in the research is 161 SS II students from four single sex secondary schools. Nkapa (1997), argues that there is no strict rule for obtaining sample size but, Frankel and Wallen (2000) recommended minimum 30 sample size. Hence this number was adequate for the study.A pretest was administered on the subject in the four schools to determine the equivalence of the subject in the sampled schools.The scores obtained from the four schools was subjected to analysis using ANCOVA to determine the equivalence in the abililty for the study sampled,(See Table 3.2b. Appendix H)

3.5 Research Instruments

The instruments used for this study were Chemistry Students' Performance Test (CSPT) and Students Motivation Questionnaire (SMQ).

Chemistry Students Performance Test (CSPT)

Chemistry Students Performance Test (CSPT) was adapted from the West African Senior Secondary School Examination (WAEC) and National Examination Council (NECO) past examinations question papers and modified to measure the overall student performance,who has been exposed to chemistry concepts by their teachers up to the SS II level. The CSPT is fourty items of objective questions with a maximum of 40 scores. The item was purposively classified to reflect the cognitive domains of educational objectives. The objective questions, has 4 options from which the students were expected to choose the correct option. The maximum score of each correct option was one (see Appendix B &C). To ascertain the internal consistency of the CSPT items a pilot testing of the instrument was admimistered to 30 SSII chemistry students in a school other than the ones that were used in the study.

Students Motivation Questionnaire (SMQ)

The Students Motivation Questionnaire (SMQ) was used to assess students' motivation towards learning chemistry. The instrument was adapted from Wachanga et al, (2010) and Buntting, Coll & Campbell (2006), and was modified to suit the study. It was constructed base on Keller's ARCS motivation theory. The Acronym ARCS stands for the conditions that must exist in a motivated learner.These are Attention, Relevance, Confidence and Satisfaction.Twenty-eight items on favourable and unfavourable statements of the students' motivation in learning chemistry was constructed on a five point likert scale. Of the 28 items, seven items are for attention, eight for relevance, eight for confidence and six for satisfaction. The participants were required to respond to each of the (SMQ) on Likert – 5 – Scale ranging from Strongly Agree (SA), Agree (A),Undecided(UD), Disagree(DA), to Strongly Disagree(SD) (See, Appendix D).

3.6 Validity of the Instruments

The Chemistry Students Performance Test (CPST) and Student Motivation Questionnaire (SQM). The CSPT was validated by two (2) senior lecturers in the department of science education Ahmadu Bello University Zaria.They were requested to examine wether the items selected are suitable for the teaching chemistry concepts in terms of clarity and cognitive demands. The items reflected the cognitive levels of Blooms texanomy for cognitive domains. They are:

Level A: Knowledge (mainly recall),

Level B: Comprehension (ability to use knowledge in familier situations),

Level C: Application (ability to collect appropriate and apply it to the problem situation),

Level D: Analysis (breaking down of materials into parts) and

Level E: Evaluation (judging the value of material for a given purpose).

However, these experts among other things critically assessed CSPT with respect to these criteria to:

a) evaluatethe test items whether they are clearly stated, readable and difficult or simple.
b) determine the number of weeks that would be suitable for conducting the study.
c) determine difficulties if any, in the activities set out for the students.
d) determine the amount of materials that would be required to effectively teach the subjects during the main study.
e) assess the clarity of the items of the CSPT and SQM
f) calculate the reliability coefficient of CSPT. Also the facility indices and difficulty indices would be determined using the scores of the students.
g) whether or not the test items are related to chemistry concepts of senior secondary school syllabus.

Their suggestions lead to the reframing and elimination of ambiguous and inappropriate statements. The 40 items on CSPT were presented for face validation.

Table 3.3: Specification of Items (Topics used in the Study) based on Bloom's Taxonomy

Unit		Knowledge	Synthesis	Analysis	APP	Comprehension	
1.	Mole	2,18,36	17	6	-s	3,10,11,27	9
2.	Mole and Avogadro's Number	1,7	-	-	34	23	4
3.	Molar mass & Avogadro's Number	14,31	8,25	20,35	-	19,24	8
4.	Mole-mass No Conversion	-	38	13,15,33	26,37	30	7
5.	Volume-amount in gases	28,16	32	-	5	29,39,40	7
6.	Mole concept	-	22	4,9,12,21	-	-	5
	Total					**40**	

Source: Adapted from Yaga (2013)

Validation of Students Motivation Questionnaire (SMQ)

The Students Motivation Questionnaire in Chemistry, (SMQ) was validated by panel of three qualified senior lecturers in the department of educational psychology, Ahmadu Bello University Zaria with Ph.D qualifications in the field of psychology. (see Appendix D). The experts were requested to:

a. study the instrument and certify if the questions were considered to be testing the motivation of students in chemistry concept.
b. certify if the items are appropriate for the level of the students under study.
c. check for possible errors in the instrument.
d. suggest appropriate corrections on the possible errors observed in the instrument.

The panel members examined the test items of the Student Motivation Questionnaire (SQM) in relation to the terms of reference outlines above. Feedback from the panel members provided useful and constructive suggestions on the basis of which some grammatical errors were corrected. The final questionnaire items certified to be free from ambiguity and of standard were evenetually obtained.

3.6.1 Pilot Testing

The instrument Chemistry Student Performance Test (CSPT) was pilot-tested in a school whose respondents have similar characteristics with those in the actual study area to determine the reliability of the instruments. The pilot study was conducted at GSS Kafin mai-yaki using 30 students, the instrument consisting 40 multiple choice items was administered to the students with assistance of chemistry teachers of the school.The instrument administered lasted only for one hour,instructions on how to answer the questions were read and explained to the students by the researcher.The reason,for the pilot study were:

i. to determine the reliability of the instruments.
ii. the approximate time that was required by the respondents to complete the test.
iii. feasibility of the instruments.
iv. the reliability of the instrument.
v. difficulty/facility index of the items
vi. to ascertain whether the student performance could be shifted by mastery learning instruments.

3.6.2 Reliability of the Instruments

The reliability of a test instrument is a function of the ability of the individual to take the test (Fraenkel & Wallen 2000) that is, it is the consistency with which it measures what it is to measure. It gives an indication of the extent to which a particular measurement is consistent and reproducible (Fraenkel et al 2000). The data generated from the pilot study was used to determined the reliability coefficient of the CSPT test items. This study employed Pearson’s Product Moment Correlation

Coefficient (PPMCC) formula on the scores obtained from the pilot study. The PPMCC formula is used because it has been found by Fraenkel et al (2000) to be particularly useful to teachers, as it requires less computation and is useful when items are in multiple response form. The result of calaculation was obtained using SPSS statistical software (Version 19.0)

Using this software a reliability, r = 0.73 was obtained. A reliability coefficient of this magnitude suggests that the instrument – CSPT was quite reliable for this study. According to fraenkal etal (2000), the method was used because of its advantage as outlined by Wiseman (2002):

- no time lag between administrations of the test, it thereby save time required for the estimation of reliability.
- it eliminate the negative effects of maturity as entire test was given to students at the time.
- it does not allow for the problems brought about by practice.
- it is readily adapatable to class room situation.

The reliability of the Student Motivation Questionnaire (SQM) was established using test retest method. The second test was administered two weeks after the administration. The two set of score were correlated to get the reliability coefficvient of the questionnaire. The reliability for SQM was r = 0.76. This indicates that the SQM is quite relaibale.

3.6.3 Item Analysis of CSPT

a. Difficulty/Facility Index of CSPT

The difficult index of the instrument was calaculated from the result of the pilot study using the split half method. The formula used was

$$DI = \frac{R_U + R_L}{T}$$

Where

DI = difficulty index of the items

R_U = no. of respondents who get the items correct in the upper group

R_L = no. of respondents who get the items correct in the lower group

T = total number of respondents.

The dificuly index (DI) of a test according to Wiseman (2002) is the percentage of candidates that got the item right. Wiseman (2002) recommended values within the range of 0.30 to 0.70 for good test item values in assessing achievement. For the present study 0.30 to 0.70 was chosen for the study. After the analysis, all items with difficulty indices below 0.2 were discarded as being too difficult while those with indices of 0.20 to 0.35 were selected for the final CSPT instrument with some modification or reframed. Items with indices of 0.30 to 0.70 were selected without any modification, while those with indices above 0.70 were modified and accepted.

b. Discrimination Index

Discriminating index on the other hand shows the discriminating power of each of the test items or the ability to separate between high and low ranking students in the whole test. The calaculation was done by using scores of top twenty seven percent (27%) and bottom twenty seven percent (27%) of the entire respondents. It is calaculated using the formula given by (Furst in Olorukooba, 2001).

$$D_1 = \frac{R_u - R_1}{\frac{1}{2}N}$$

Where

D_1 = discriminating index

R_u = number among upper 27% of respondents

R_l = number among lower 27% of respondents

N = total number of respondents

For the present study, the discrimination index of 0.30 to 0.70 was used since it is moderately positive, in selecting the final item of CSPT.

3.7 Administration of the Treatment

Mastery learning strategy is a method of teaching which provides the learner with a set of instructional objectives per unit tasks and allows much time as necessary to enable individual learner master the objectives of each unit.

By implications there are two major approaches: the group based approach and individual based approach. The experimental group was exposed to special treatment on mole concept, mole and Avogadro's number, molar mass, Avogadro's mole-mass number conversion and volume-amount in gases using Avogadro's number. However, in conducting the instructions the researcher used the group based approach, which is one of the major approaches based on mastery learning principles. The programmed materials were divided into units of instructions on topic at hand. Each unit in the programmed material introduces a new concept whose understanding is linked to proper conceptualization of concepts obtained on proceeding units' frames. At the end of each unit lesson, one item test were given to identify the students' performance.

The researcher however gave some guidance such as initial orientation to experimental group to acquaint them on what they were expected to learn, how to learn and demonstration of what has been learnt.

Teaching the Experimental Group using Mastery Learning Instructional Strategy

Mastery learning is an instructional strategy based on the idea of giving the students more than one chance to demonstrate mastery of content and skills. In mastery learning classroom as in traditional classroom, students receive instruction on a topic and then take a test to determine their level of understanding. But that is where the similarities ends. In mastery learning classroom the teacher scores that assessment and determine who has mastered the content and who needs more help. Students who have mastery the materials are given the "enrichment" opportunities while those who have not mastered it receive additional instruction on the topic.

The experimental groups were taught using mastery learning instructional strategy on mole concept and its application using the mastery learning instructional strategy model for the period of six weeks. In every week, the concept was treated using double contact lesson that is 90 minutes. The detail showing how the strategy was used is presented in Figure 3.

The procedures for mastery learning as designed by Bloom (1968) in Uche et al,(2012) are as follows:

STEP 1: Break the course or subject into smaller units, such as a chapter in a textbook, a well defined segment of content which may involve one to two weeks of learning activity. The units should range from specific terms or facts to more complex and abstract ideas such as concepts and principles to more complex processes such as application of principles and analysis of theoretical statements. Such elements are considered as forming hierarchy of learning tasks. It is very necessary that students have mastery of unit one before moving to unit two.

STEP 2: Determine unit objectives and mastery level i.e. the optimal learning level expected for the learners before they will move to the next unit.

STEP3: Construct formative test for each unit to determine which of the units tasks the students has mastered or not mastered. At this level students are informed that the tests are used to determine their mastery of a particular unit and are not graded.

STEP 4: The formative test is determined and scored using items like mastery and non mastery. Use of grade is avoided to remove tension and anxiety on the learners. For students who have thoroughly mastered the unit, the formative test reinforces their learning and assures them that their learning approach and study habits are adequate. The formative test also reduces anxiety about end of course achievement for learners who consistently demonstrate unit mastery. For the learners who lack mastery of the unit, the formative test reveals the particular areas of difficulty and the ideas, skills and processes still needed to work on. The formative test also provides feedback to the teacher, because they can be used to identify particular points in the instruction that need modification. It can also serve as quality control in future cycles of the course, the students performances on each test may be compared with the norms for previous years to ensure that they are doing as well or better.

STEP 5: Use corrective learning procedure for learning difficulties discovered after the administration of formative test. The correctives are designed to re involve the learners in learning the course unit in ways that differ from the original group based instruction. This makes it possible to adapt instructional methods and materials to the need of all learners, improves interest, motivation, attitude, perception and shifts the entire achievement distribution upwards. Some of the corrective learning procedures include small group study session, tutorials, rereading particular pages of the original instructional materials, studying specific pages or workbooks or programmed materials, use of flash cards, re-teaching etc. The learners learn which correctives that work best for them and their later learning becomes more efficient. The extra time spent pays dividend on later learning.

STEP 6: After using the necessary corrective learning procedures, the formative test is re-administered on the learners to determine the effect of the procedures on them. If the majorities have attained mastery, the class moves to the next unit.

The figure below illustrates the flow chart showing the steps model of mastery learning instructional strategy used during the teaching periods. At the end of the six weeks the Chemistry Students Performance Test (CSPT) was administered as post-test to the students.

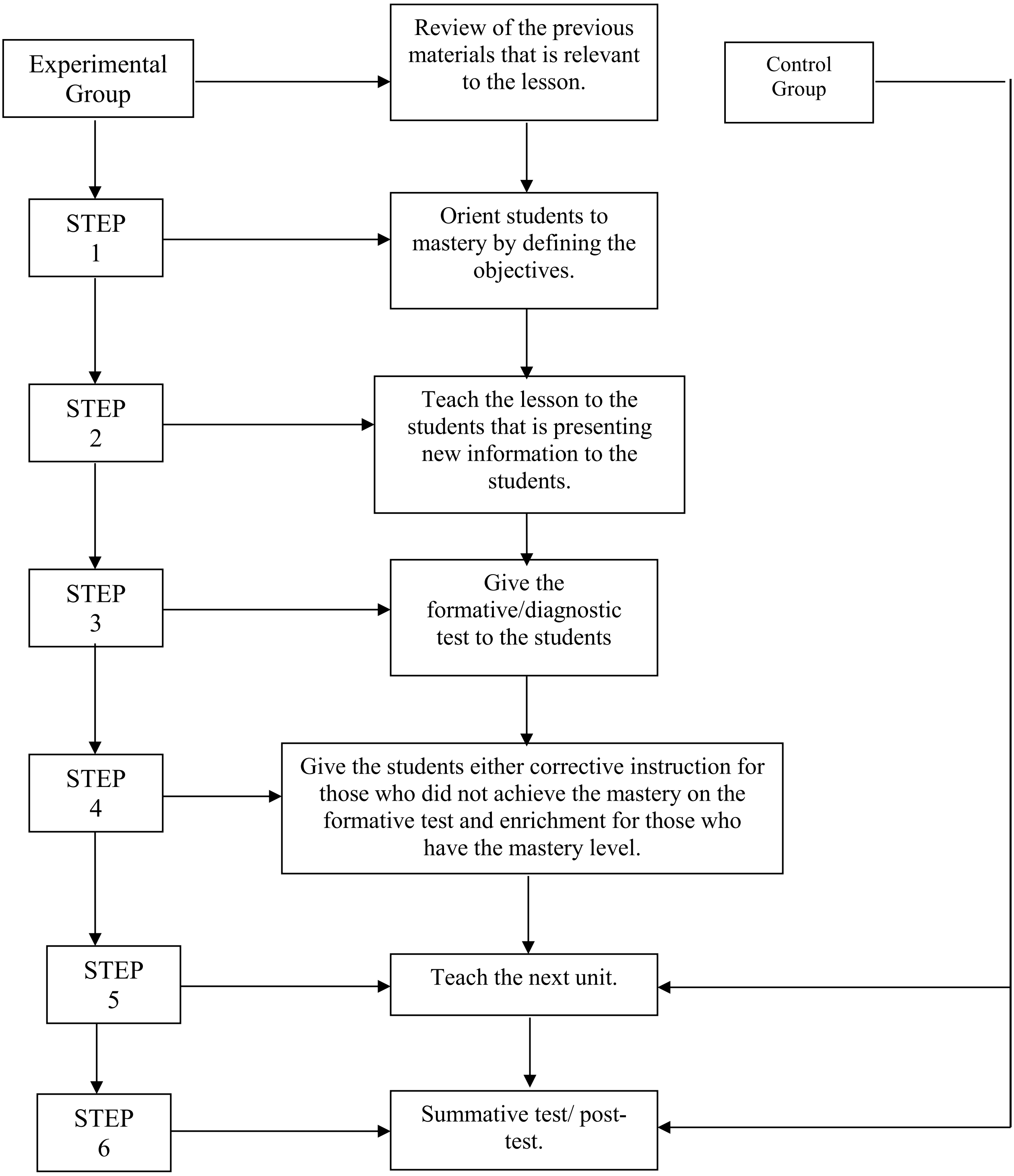


Figure 3: Flow Chart of Mastery Learning Instructional Strategy

Source: Adopted from Bloom (1968) in Uche et al. (2012)

Teaching the Control Group using Lecture Method

The control group was taught the same chemistry concepts by the researcher using lecture method. They were exposed to the teaching using this (lecture) method for a period of six weeks of 1hour 30 minutes lesson twice a week. The teaching notes prepared by the researcher and validated by panel of educationists were strictly adhered to in the teaching of the control groups (see Appendix E). The lessons were presented by lecture method with important points written on the chalkboard. Notes were given to the subjects after each teaching period. The subjects were referred to relevant chemistry textbooks for more information. Written assignments were given to the subjects after each lesson. The entire teaching lasted for a period of six weeks. The Students Motivation Questionaire was administered to the control groups before and after six weeks of teaching. The posttest was administered to the groups a week after the last lessons. The different scores obtaioned during pretest and posttest were used for data analysis.

3.8 Data Collection Procedure

At the end of the treatment the experimental and control groups were given post test and students mastery learning motivation questionnaire to deternine the effectiveness of the treatment. The two groups (Experimental and Control) were given Chemistry Students Perforfomance Test and Student Motivation Questionnaire to answer. The scripts were marked with maximum of fourty (40) marks as presenteted in the marking scheme in appendix C. Later the scores of the four grups were recorded and separated based on their performance levels.

3.9 Procedure for Data Analysis

Thus the methods of data analysis were taken as follows:

In analysing the data obtained, various statistical methods were used. These included mean and standard deviation for descriptive statistics. The data collected for the purpose of this study were analyzed in two folds; The data obtained from CSPT was subjected to test the stated hypotheses at $P \leq 0.05$ level of significance, as follows;

$H0_1$: There is no significant difference between the mean performance scores of students taught chemistry using mastery learning instructional-strategy and those taught using lecture method.

Comparative sample t-test analysis was done in respect to this hypothesis.

$H0_2$: There is no significant difference in the mean performance scores between male and female students taught chemistry using mastery learning instructional-strategy.

In respond to this hypothesis independent sample t-test statistics was used to test whether the effect of the treatment and and performance mean scores of students in chemistry co-varied with gender of the students.

$H0_3$: There is no significant difference between the mean motivation scores of students' taught chemistry using mastery learning instructional-strategy and those taught using lecture method.

In response to this hypothesis Mann Whitney U test statistics was conducted.

$H0_4$: There is no significant difference between mean motivation scores of males and females student' who are exposed to mastery learning instructional-strategy.

Mann- Whitney U test statistics was used in testing this hypothesis.

This analysis was done with help of Statistical Package for Social Sciences (SPSS) version 19.0. To make reliable inference from the data, all statistical tests were tested for significance at alpha (α) level of 0.05.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This study investigated the effects of mastery learning instructional strategy on senior secondary school chemistry students' motivation and academic performance in Karaye education zone, Kano state-Nigeria.

This chapter presented the results and interpretation after analyzing the data collected, under the following headings:

4.2 Data Presentation, answering the research questions and Null hypotheses testing.

4.3 Findings and

4.4 Discussion of the Results

4.2.0 Data Analysis

4.2.1 Answering the Research Questions

The purpose of this study was to determine the effects of mastery instructional-strategy on senior secondary school chemistry students' motivation towards learning and performance. In achieving this purpose, answers were sought to the following questions.

Research Question One

What is the difference between the mean academic performance scores of students'taught chemistry using mastery learning instructional strategy and those taught using lecture method?

This research question was answered using descriptive statistics of means and standard deviations. The summary of the analysis is presented in Table 4.01.

Table 4.01 Means and Standard Deviations of Chemistry Students Performance in Experimental and Control Groups

Group	N	Mean	SD	Std. Error Mean	Mean Difference
Experimental	89	33.90	3.681	.390	
Control	72	25.13	2.355	.278	8.774
Total	**161**				

Table 4.01 shows the mean performance scores in Chemistry for experimental and control groups. The performance mean scores for the experimental group (M=33.90, SD=3.681) was higher than that of control group (M=25.13, SD=2.355). The mean difference between the two groups was 8.774 in favor of the experimental group. This indicated that the the experimental group benefited more in training then the control group.

Research Question Two

What is the the difference between the mean academic performance scores of male and female students' taught chemistry using the mastery learning instructional-strategy?

This research question was answered using descriptive statistics of means and standard deviations. The summary of the analysis is presented in Table 4.02.

Table 4.02 Means and Standard Deviations on Chemistry Performance for Males and Females in Experimental Group

Sex	N	Mean	SD	Std. Error Mean	Mean Difference
Male	45	37.07	1.970	.294	
Female	44	30.66	1.584	.239	6.408
Total	**89**				

Table 4.02 shows the performance mean scores in Chemistry for male and female students in the experimental group. The mean performance scores for the male (M=37.07, SD=1.970) was higher than that of female (M=30.66, SD=1.584). The mean difference between male and female was 6.408 in favor of the male students.

This indicated that there was a difference between the mean performance scores of male and female students was in favour of male students taught chemistry using mastery learning method.

Research Question Three

What is the difference between the mean motivation scores of students taught chemistry using mastery learning instructional-strategy and those taught using lecture method?

This research question was answered using non-parametric statistic of mean ranks. The summary of the analysis is presented in Table 4.03.

Table 4.03 Mean Ranks on Motivation Score for Experimental and Control Groups

Group	**N**	**Mean Rank**	**Mean rank difference**	**Sum of Ranks**
Experimental	89	116.04	78.65	10327.50
Control	72	37.69		2713.50
Total	**161**			

Table 4.03 shows the mean ranks on motivation score for experimental and control groups. The mean rank on motivation for experimental group was (M=116.04) and that of control group was (M=37.69). The mean rank difference was 78.65 in favor of the experimental group.This showed that mastery learning motivates students more than the lecture method.

Research Question Four

What is the difference between the mean motivation scores of male and female students taught chemistry using mastery learning instructional strategy?

This research question was answered using non-parametric statistic of mean ranks. The summary of the analysis is presented in Table 4.04.

Table 4.04 Mean Ranks on Motivation of Males and Females Chemistry Students in Experimental group

Sex	N	Mean Rank	Mean rank difference	Sum of Ranks
Male	45	51.87	13.89	2334.00
Female	44	37.98		1671.00
Total	**89**			

Table 4.04 shows the mean ranks on motivation score for male and female students in the experimental group. The mean rank on motivation for male was (M=51.87) and that of female was (M=37.98). The mean rank difference was 13.87 in favor of the male students.

This showed that mastery learning motivates male students more than the female students.

4.2.2 Testing the Null Hypotheses

There were four null hypotheses stated and tested in this study. Null hypotheses 1 and 2 were tested using sample t-test, while null hypotheses 3 and 4 were tested using non-parametric test of Mann-Whitney U test. All the null hypotheses formulated in this study were tested at $p \leq 0.05$.

Null Hypothesis One

There is no significant difference between the mean performance scores of students taught chemistry using mastery learning instructional-strategy and those taught using lecture method.

This null hypothesis was tested using independent samples t-test. The result of the analysis is presented in Table 4.05.

Table:4.05 Summary of Independent t-test Analysis of Mean performance Scores of Chemistry in Experimental and Control Groups

Group	N	Mean	SD	Std. Error Mean	t	Df	p-value	R
Experimental	89	33.90	3.681	.390				
Control	72	25.13	2.355	.278	17.526	159	0.00	Sig
Total	**161**							

$P \leq 0.05$

Table 4.05 shows the performance mean scores in Chemistry for experimental and control groups. The mean performance scores for the experimental group (M=33.90, SD=3.681) was higher than that of control group (M=25.13, SD=2.355). The mean difference between the two groups was 8.774 in favor of the experimental group. Since the obtained p-value of 0.00 is less than 0.05 leve of significance, the null hypothesis that stated no significant difference is rejected. This indicated that there was a significant difference between the performancemean scores of students taught chemistry using mastery learning and those taught using lecture method in favour of experimental group.

Null Hypothesis Two

There is no significant difference between the mean performance scores of male and female students taught chemistry using mastery learning instructional-strategy.

This null hypothesis was tested using independent samples t-test. The result of the analysis is presented in Table 4.06.

Table:4.06 Summary of Independent t-test Analysis of Mean Performance Scores of Chemistry Students for Males and Females in Experimental Group

Sex	N	Mean	SD	Std. Error Mean	Mean Difference	t	Df	p-value	R
Male	45	37.07	1.970	.294					
Female	44	30.66	1.584	.239	6.408	16.886	87	0.000	Sig
Total	**89**								

$P \leq 0.05$

Table 4.06 shows the performance mean scores in Chemistry for male and female students in the experimental group. The mean performance scores for the male (M=37.07, SD=1.970) was higher than that of female (M=30.66, SD=1.584). The mean difference between male and female was 6.408 in favor of the male students. Since the obtained p-value is less than 0.05 level of significance, the null hypothesis that stated no significant difference was rejected. This indicated that there was a significant difference between the performancemean scores of male and female students taught chemistry using mastery learning method in favour of male students.

Null Hypothesis Three

There is no significant difference between the mean motivation scores of students taught chemistry using mastery learning instructional-strategy and those taught using lecture method.

This null hypothesis was tested using non-parametric statistics of Mann-Whiney U test. The result of the analysis is presented in Table 4.07.

Table 4.07 Summary of Mann-Whiney U test of Rank Mean Score of Motivation in Experimental and Control Groups

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Z	p-value R
Experimental	89	116.04	10327.50	85.500	-10.619	000Sig
Control	72	37.69	2713.50			
Total	**161**					

$P \leq 0.05$

Table 4.07 shows the mean ranks on motivation score for experimental and control groups. The mean rank on motivation for experimental group was (M=116.04) and that of control group was (M=37.69). The mean rank difference was 78.65 in favor of the experimental group. As the obtained p-value is less than 0.05 level of significance, the null hypothesis that of no significant difference was rejected. This showed that there was a significant difference between the mean ranks scores on motivation of students taught chemistry using mastery learning and those taught using the lecture method.

Null Hypothesis Four

There is no significant difference between the mean motivation scores of male and female students who are exposed to mastery learning instructional-strategy.

This null hypothesis was tested using non-parametric statistic of Mann-Whiney U test. The result of the analysis is presented in Table 4.08.

Table 4.08 Summary of Mann-Whiney U test on Motivation Scores in Chemistry for Malesand Femalesin Experimental Group

Sex	N	Mean Rank	Sum of Ranks	Mann-Whitney	Z	p-value	R
Male	45	51.87	2334.00	681.000	-2.552	0.011	Sig
Female	44	37.98	1671.00				
Total	**89**						

$P \leq 0.05$

Table 4.08 shows the mean ranks on motivation score for male and female students in the experimental group was 51.87 and 37.98 respectively. The mean rank difference was 13.87 in favour of the male students. As the p-value obtained is less than 0.05 level of significance, the null hypothesis that expected a no significant difference in the mean rank score was rejected. This showed that there was a significant difference between the mean rank scores on motivation of male students taught chemistry using mastery learning and female students taught using the same method.

4.3 Findings

1. There was significant difference between the posttest mean perfomance scores of students taught chemistry using mastery learning instructional strategy and those taught using lecture method in favour of experimental group.

2. There was significant difference between the mean performance scores of male and female in favour of males after exposure, to mastery learning strategy in favour of male students.
3. There was significant difference between the mean motivation scores of students taught chemistry using mastery learning strategy and those taught using lecture method in favour of experimental group.
4. There was significant difference between the mean motivation scores of male and female students taught chemistry using mastery learning strategy in favour of male students.

4.4 Discussion of Results

The objective of this study was to investigate the Effects of Mastery Learning Strategy on Senior Secondary School Chemistry Students Motivation and Academic Performance in Karaye Education Zone Kano State, Nigeria. To achieve this, two groups of students were formed, the experimental and control groups. Students in experimental group were exposed to mastery learning teaching strategy while those in control group were exposed to lecturer method. The two groups were taught the same chemistry concept (mole concept and its applications). The data of this study were based on Chemistry Students' Performance Test (CSPT) and responses obtain from Student Motivation Questionnaire (SQM). The result of posttest was used to compare their performance according the variables being measured which were analyzed according to the research hypotheses developed for the study. However this unit presented explanation of results obtained from the hypotheses tested and acknowledged the published works of other authors to be stated herein after. Based on the findings of this study, it was reveal that mastery learning strategy was found more effective if teachers can do extra work to drill the students in mastering more of the chemistry concepts, principles and theories.

Similarly, if the teacher can adopt the techniques of mastery learning in a normal classroom setting, because it is effective in teaching basic skills and knowledge to slow learners and reduces competition among students regarding what is to be tested and such test as formative test become diagnostic tools for teachers to make decision with the classroom.

The research questions and hypotheses revealed that using the mastery learning instruction has facilitated better performance of chemistry students and motivation in the experimental group. This has been so, because, there existed statistically significant difference between the mean performance score of the experimental and control group in favour of experimental group which participated in the classroom instruction of mastery learning strategy.The results were discussed as follows:

Null Hypothesis One

The result in table 4.05 revealed that the use of mastery learning significantly enhanced the academic performance of students who were exposed to it. Their performance was significantly higher than that of the students exposed to lecture method. The result obtained in this study could be due to the unique characteristics of mastery learning strategy of giving the learners the opportunity to interact with one another and share ideas freely and correct one another which promote meaningful learning, motivation and achievement. The findings of this study agrees with that of Wachanga et al (2010), who also discovered that students in mastery learning class performed significantly better than those taught using lecture method. However, Olorundare et al (2015), also revealed similar result in their study on the effects of mastery learning strategy on students academic performance in mole concept. In their study, students taught mole concept using mastery learning strategy performed significantly better than those taught using the lecture method.

This is in line with position of Bot (2004) who found mastery learning instructions is the best in teaching and learning mathematics, in normal classroom. He formed groups of students which are taught by the mastery learning instructions and conventional approach and found that the group taught by mastery learning instructions performed significantly better than their counterpart. This could be attributed to the fact that the first lesson was prerequisite to the next lesson.

The strategy facilitated a better understanding and performance of chemistry concepts as students were not allowed to learn new lesson until the previous one was understood.The result also is consistent with Kazu, Kazu and Ozedemi (2005) and Pepple (2014) in their separate researches on the effects of mastery learning strategy, revealed that mastery learning enhances students academic achievement more than the lecture method. This is because mastery learning, accounted for the high student academic performance of the students in experimental group.

In mastery learning students realized the importance of formative test given and corrective instructions on the success of individual students. This gives room for each students to pay more attention to the discussion so that every body is carried along. It is however, believed that mastery learning strategy enhenced the level of conceptual understanding of every students improvement and each student may have understand the new concept taught before moving to ther next unit.

Null Hypothesis Two

The results from table 4.06 revealed that there was a significantly difference in students academic achievement. From the result obtained it was observed that male students had higher mean performance scores than their female counter parts when both were exposed to mastery learning strategy. This is because male students are known for their unique characteristics of possessing higher order thinking skills, love discussion and love learning more difficult task as identified by Okeke (2008). The difference of this finding might be attributed to the abstract nature of the concept taught, traditional practices inhibiting females from active participation, for example, early marriage, this hinders the girls-child enrolement, attendance and retention in schools. However, poor parents attitude and husbands in education also influence their performance in schools this discourage them to study science hence the less improvement in the science subjects. This indicates that males performed better than females, this is in line with Oconnor (2001) and Bot (2004),theyboth found in their studies that, mastery learning strategy favour males students' betterthan their females students' counterparts in mathematics.Joyce (2006), also pointed out that local customs and values powerfully discourage women from going into science and those that do it, do not strive for achievement.

Furthermore, Burill (2004) said that both male and female expose to mastery learning approach in the experimental group performed significantly better than those in control group. This largely was due to the influence of mastery learning strategy experimental group received.This finding is also in line with Okeke (2008) who found a significant difference between the performance of male and female studentsusing different strategy. He stated that male students often perform better than their female classmates in science subjects. Similarly, Amusat and Awoyemi (2006) on the influence of gender on students' level of achievement in chemistry concluded that gender difference has influence on students' level of achievement at secondary school level. According to them, there are many factors causing gender differences in performance in science in Nigerian schools. Many of these factors are man-made and can be avoided if the country is ready to pay the price. Different communities have different view of formal education, some belief female education is not important. Some communities belief women should be restricted to their traditional role of full time housewife, as mother and house keeper, permissible vocations for women include teaching or nursing. Such communities do not encourage women into science and technical courses such as engineering.

However, this study disagrees with Wachanga et al (2010), Olorundare et al (2015) and Pepple (2014) that reported that no significant different exists in the performance means scores of students due to gender. The inconsistencies in this findings of studies reviewed are indication that gender factor in achievement remain an issue requiring diversified attention.

Null Hypothesis Three

From the results in Table 4.07 there was a significant different between the mean motivation scores of experimental and control groups, which is in conformity with Wachanga et al (2010), John et ai, (2014) and Olorundare et al (2015) which shows that mastery learning instructional strategy improve the students performance and motivation. The reason for this was that pre-requisite steps of activities in teaching mole concepts and its application were followed. This has stimulated student's motivation, attention that led to good performance in the concept. The students in the experimental group were motivated because of mastering small units of instructional objectives and can therefore, build confidence as they proceed to the next unit of instruction.Thiswill facilate a sense of relatedness,that is advocated by self- determination theory, (Deci & Ryan, 2000). However, a corrective feedback given to students immediately, enable them to to know the areas of their weakness and work on them. This enhances their motivation and allow the students to gain satisfaction in completing the task successfully, that is as students understand a content tauht build a compentence in them who are likely to adopt and intrnilized what they understand and have relevant skills to succeed it. Furthermore this finding was also consistent with findings of other researchers, studies by Signh, Granville and Dike (2003), Nelson, (2003) and Geary and Hamson (2007) who indicated that, motivation has a very strong influence on student's achievement in science. The motivational effect found in this study which is a relatively large, show that the treatment raised the experimental students scores above the control group.

Null Hypothesis Four

The result in table 4.08, revealed significant difference in the effect of mastery learning strategy on motivation of male and female students exposed to it in the study. This null hypothesis of no significant different was therefore rejected. The finding here implies that males student enjoy more learning difficult task in the study more than the female counterparts when they are exposed to mastery learning strategy. The result obtained of here may be due to the abstract nature of the concept taught, encouragement and support from single sex educational settings in the study area. This encouragement and single sex educational settings maybe as one of the sources of motivation responsible for the gender differences between the male and female students.This finding is in line with research carried out by Kean and Eccles (2006) that males hold higher motivation of science ability and science value than females. Catsambis (1995), reported that the interest, participation and achievement in advanced level high school science courses are lower for girls than boys. This is as a result of of differential educational experience offered to boys and girls in the classroom. Githua and Mwagi (2003), concurred with this findings since they found a significant gender difference, favouring boys in students motivation to learn mathematics. This practice make girls feel incapable to achieve set of goals as compared to boys, hence female students seemed to express the highiest doubt in their capabilities, this variation in confidence will affect their performance and motivation in learning chemistry. The high motivation scores found between the male and female students may have resulted from conducive learning environment and opportunity for motivation created by single sex educational programme. This finding also agreed, with findings of Hutchison and Smithoman (2002). They both found males and females benefits from motivation in single sex educational programme. This finding of this study was inconsisting with findings of Wachanga et al (2010), and Olurandare et al (2015), who found in their separate researches no gender difference, between male and female students motivation when they were exposed to mastery learning physics and chemistry concepts respectively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter was discussed under the following sub- headings:

- Summary of the Study
- Conclusion
- Recommendations
- Contributions to Knowledge
- Limitation of the Study
- Suggestions for further Studies

5.2 Summary of the Study

The study was conducted to find the effects of mastery learning strategy on senior secondary school chemistry students motivation and academic performance in Karaye Education Zone, Kano State. To achieve these two groups of students were formed, one gropup the experimental gropup was exposed to mastery learning instructional strategy and the other group the control group was exposed to lecture method. The effect of the method in academic performance, motivation and gender were deduced.

The sample size for the study comprised a total of 161 senior secondary two (SS II) chemistry students drawn from four secondary schools in Karaye Educaiton Zone, Kano State. Two schools served as the experimental group i.e. GSS Karaye and GGSS Karaye. These schools were taught using mastery learning strategy. The control groups were GSS Zarewa and GGSC Karaye who were taught using lecture method. Mole concept and its applications was chosen for the research.

Two instruments were used Chemistry Students Performance Test (CSPT) a fourty (40) multiple choice instrument and student motivation questionnaire. Four null hypotheses were tested to answer the stated research questions. The study adopted pretest – posttest Quasi Experimental Research design. The treatment for the study involves teaching the experimental group concepts in chemistry using mastery learning strategy and teaching the control gropup same chemistry concepts using lecture method.

A pretest was administered to the experiemental group and control group before the commencement of treatment. The treatment lasted for six weeks, after which posttest was administered to both groups. The Students Motivation Questionnaire (SQM) was also administered to both groups.

The data generated were analysed according to the hypotheses. The data was analyzed using SPSS statistical version 19.0. The confidence limit 0.05 was adopted for retaining or rejecting the hypotheses.

The summaries of the findings from the results are as follows:

i. There is significant difference between the academic performance of students exposed to mastery learning strategy and those exposed to lecture method of chemistry students in favour of experimental group among SS II chemistry secondary school students in Karaye Educaiton Zone, Kano State.
ii. There is significant difference between the academic performance of male and female students exposed to mastery learning strategy in favour of male students among SS II chemistry senior secondary school students in Karaye Educaiton Zone, Kano State.
iii. There is signifncant difference between the motivation of students taught chemistry using mastery learning strategy and those taught chemistry concepts

using lecture method in favour of experimental group among SS II senior secondary school chemistry students in Karaye Education Zone, Kano State.

iv. There is significant difference in motivation of male and female students taught chemistry using mastery learning strategy in favour of male students among SS II senior secondary school chermistry students in Karaye Education Zone, Kano State.

5.3 Conclusion

1. Academic performance in teaching chemistry can be enhanced by the use of mastery learning teaching strategy.
2. Motivation level of students toward chemistry can be enhanced by the use of mastery learning teaching strategy.
3. The finding of this study showed that mastery learning teaching strategy has the potential of enhancing senior secondary school chemistry students academic performance and motivation, hence there was drastic improvement between the the performance and motivation after the treatment.

5.4 Contributions to Knowledge

The concern of this study was to examine the effects of mastery learning strategy on senior secondary school chemistry student's motivation and academic performance in Karaye education zone Kano State. The findings of this study have significant contributions and great implication for educational practices;

1. The researcher developed Chemistry Students Performance Test (CSPT) that can be used by the other researchers.
2. Mastery learning teaching strategy significantly improved the academic achievement of chemistry students who were exposed to it.

3. The male students learn better with use of mastery learning teaching strategy then female students.
4. This is the first study of its kind in Karaye education zone, Kano State and could be replicated by other researchers in other educational zones within the state or other states within Nigeria.

5.5 Recommendations

Based on the findings from this study the following recommendations were made;

1. Chemistry teachers should take advantage of the mastery learning instructional strategy in teaching mole concept and other related concepts in chemistry.
2. Gender of the students should be given equal consideration more as far as the use of mastery learning instructional strategy is concerned since gender has influence on the academic performance of students with mastery learning strategy, even though it minimize gender disparities.
3. The Federal and State Ministries of Education and other educational bodies like Nigerian Educational Research and Development Council (NERDC) and Science Teachers Association of Nigeria (STAN) should organize training/workshop for teachers so as to update their knowledge on the use of mastery learning instructional strategy to improve teaching and learning in Nigerian schools.
4. Curriculum developers in their effort to improve the effectiveness of chemistry teachers should encourage the use of mastery learning instructional strategy.
5. Teacher training programmes should also make the use of mastery learning strategy as part of their teacher education curriculum.

6. Teachers should motivate and encourage students to work hard in order to achieve their goals by using motivational strategies such as the mastery learning instructional strategy.

5.6 Limitations of the Study

The following limitations were noted in the course of this study:

1. It took the researcher extra efforts and time to teach and educate the students on the procedure and use of mastery learning strategy to make the teaching more effective.
2. The schools used for the study were government owned; the situation may be different in private schools. Thus, the finding may not imply on private schools.
3. The researcher restricted his study to Karaye Education Zone Kano State, the situation may be different in other educational zones of the state. This might affect generalization made on the findings.

5. Suggestions for Further Studies.

Based on the findings of this study the following suggestion may be found useful:

1. A similar study should be conducted involving secondary schools in other educational zones. Effort should also be made to cover both government and private schools.
2. The result obtained in this study apply only to chemistry, a similar research can be conducted in other science desplines(Physics, Biology and Integrated Science).

3. The study should be replicated out at tertiary institutions like colleges of educations, polytechnics and schools of basic and remedial studies to compare their findings.
4. This type of study could be expanded to other states of the federations for wider and more generalized scopes of the findings of such studies.

REFERENCES

Abadom, G. N. (2002).*New Strategies for Optimizing Learning Outcomes in Mathematics.*Ibadan publishers PLC

Abosede, M.E. (2010). Gender and Socio-Economic Status as Correlate of Students' Academic Achievement in Senior Secondary School.*European Scientific Journal* 8 (4) 23-36.

Achimugu, L. (2011) Strategies for Effective Conduct of Practical Chemistry Works In Senior Secondary Schools in Nigeria*. Journal of the Science Teachers Association of Nigeria.* 46, (2) 130-142.

Adepoju, O. A. (2014). Mnemonic as an Innovative Approach to Creative Teaching of Secondary School Chemistry.*African Journal of Chemistry Education* (AJCE) 4(2) 122-138..

Adepoju, T. (2001). Location, Factors as correlates of Private and Academic Performance of Secondary Schools in Oyo state. *A Proposal Paper Presented at the Higher Students.* Joint Staff Semina Department of Teacher Education University of Ibadan.

Adesoji, F. A. (2008). Students Ability Levels and Effectiveness of Problem Solving Instructional Strategy.*Journal of Social Science*.;17(1):5-8.

Adesoji, F. A. (2015). The Effect of Homogeneous and Heterogeneous Gender and Cooperative Learning Strategies on Students' Achievement in Chemistry.*British Journal of Education, Society & Behavioural Science* 11(3) 1-12.

Adesokan, C. O. (2002). Students Attitude and Gender as Determinants of Performance in J.S.S Integrated Science. *A Special Seminar by West African Examination Council.* Lagos 7th May,2007.

Adeyegbe, S. O. (2005). In Search of Indices for Measuring the Standard of Education:a Need for a Shift in Paradigm. *A Special Seminar by West African Examinations Council.*Lagos 7th May, 2007

Adeyemi, B. A. (2007). *Learning Social Studies Through Mastery Approach.*Retrieved fromhttp://www.academicjournals.org/ERR.

Agomuoh, P. (2010). Effect of Prior Knowledge, Exploration, Discussion, Dissatisfaction with Prior Knowledge and Application (PEDDA) and The Learning Cycle (TLC) Constructivist Instructional Models on Students' Conceptual Change and Retention. An Unpublished Ph.D. Thesis, Department of Education University of Nigeria, Nsukka.

Ahiakwo, M. O. G. (2002). Mathematics Achievement and Academic Performance in Chemistry.*The Nigerian Teacher Today,* 8 (1&2) 77-83.

Akinsola,M.K.(2007),Correlate of Academic Procrastination and Mathematic. Achievement of University Undergraduate Students.*Eurasia Journal of Mathematics and Technical Education* 3(4) 363-370.

Akpan, J.P. (1997). Using a Computer Simulation before Dissection to help Students Learn Anatomy. *Journal of Computer in Mathematics and Science Teaching,* 19 (3) 297-313.

Alao, A. A. & Abubakar, R. B. (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,* 1(1), 129-137.

Al-Khatib, S. (2010).Meta-Cognitive Self-Regulated Learning and Motivational Beliefs as Predictors of College Students' Performance.*International Journal for Research in Education,* 27(8), 57-71.

Ameh, P. O. & Dantani, Y. S. (2012).Effects of Lecture and Demonstration Methods on the Academic Achievement of Students in Chemistry in Nassarawa Local Government Area of Kano State.*International Journal of Modern Social Sciences*1(1),29-37.

Amelink, C. (2009). Literature Overview: Gender Differences in Science Achievement. Retrieved, from http// www.engr.psu.edu/awe/arps/arp.

Amunga, J. K., Amadalo, M. M., & Musera, G. (2011). Disparities in Chemistry and Biology Achievement in Secondary Schools: Implications for Vision 2030. *International Journal of Humanities and Social Science,* 7(18), 226-236.

Amusat, K. & Awoyemi, D. S. (2006).Gender Difficultues in the Learning of Biology Concepts in the Era of Technology.*Journal of the Science Teachers Associaiton of Nigeria.* 41 (1 & 2) 52 – 56.

Anderson, J. R. (2000). *Learning and memory: An Integrated Approach (2nd edition.).* New York: John Wiley and Sons, Inc.

Arigbabu, A. A., & Mji, A. (2004). Is Gender a Factor in Mathematics performance Among Nigerian Pre-Service Teachers? *Sex Role, 51(11) & 12),* 749- 752.

Aschbacher, P. R., & Li, E. (2010). Is Science Me? High School Students Identities, Participation and Aspiration in Science, Engineering and Medicine.*Journal of Residence Science and Technology* 47 (5) 564-582.

Ausubel, D. P. (2000).*The Acquisition and Retention of Knowledge:*A Cognitive View. Kluwer Academic Publishers

Baal, C. R. & Stevens, R. H. (2007).Student Motivation and Performance in Scientific Problem Solving Simulations. In R. Luckin, K. R. Koedinger, & J. Greer (Eds.), *Artificial intelligence in education: Building Technology Rich Learning Contexts that Work* (pp. 539-541). Amsterdam: IOS Press.

Bain, K. (2004), *What the Best College Teachers do.*Harvard University Press.

Baker, S. C. & Maciyntyre, P. D. (2003).The Role of Gender and Immersion in Communication and Second Language Orientations. In Dornyei, Z. (Ed.) *Attitudes, Orientation and Motivation Language Learning.* Wiley-Blackwell.

Baum, W. M. (2005). *Understanding Behaviorism: Behavior, Culture and Evolution.*Maiden MA: Blackwell Publishing.

Benabou, R. & Tirole, J. (2003).Intrinsic and Extrinsic Motivation.*Review of Economic Studies, 70,* 489-520.

Bidjerano, T. (2005).*Gender Differences in Self-Regulated Learning.*Retrieved December 14, 2013, from http://eric.ed.gov/?id=ED490777

Bilesanmi-Awoderu, J. B. (2006). Effect of Computer-Assisted Instruction and Simulation/Games on the Academic Achievement of Secondary School Students' in Biology.*Sokoto Educational Review, 8(1),* 49-60.

Bloom B.S. (1974). Time and Learning. *American Psychologist,* 29 (9), 4-16.

Bloom, B. (1968).Learning for Mastery.*Evaluation Comment,1(2),* 1-5. Los Angeles Centre for Study of Evaluation Instructional Programmes (UCCLA).

Bloom, B. S. & Carrol, J. (1974). Time and Learning. *American Psychologist, 29(9),* 682-688.

Bloom, B. S. (1984). The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as one-on-one Tutoring. *Educational Researcher,* 13(6), 4-16.

Bloom, B. S. (1984).*All Our Children Learning.* New York: McGraw-Hill.

Bloom, B. S. (1987). A Response to Slavin's "Mastery Learning Reconsidered. *Review of Educational Research,* 57(4), 507-508.

Bolte, C. & Halbrook, S. (2011).*Evaluating student Gains in the PROFILES Project*.European Science Educational Research Association (ESERA), Lyon, France.

Borg, W.K. & Gall, MD (1989). *Education Research. An introduction.* New York (4th Edition) Longman Inc.

Bot, T. O. (2004).Improving School Mathematics Teaching using Learning Groups.*UniJos Journal of Educational Studies* 2(3) 83 – 88.

Britner, S. L. & Pajares, P. (2006).Sources of Science Self-Efficacy Beliefs of Middle School Students.*Journal of Research in Science Teaching,* 43 (5) 485-499.

Britner, S. L., &Pajares, F. (2006). Sources of Science Self-Efficacy Beliefs of Middle School Students.*Journal of Research in Science Teaching, 43(5),* 485-499.

Broussard, S. C., & Garrison, M. E. (2004). The Relationship Between Classroom Motivation and Academic Achievement In Elementary School-Aged Children. *Family Consumer Science Research Journal, 33(2),* 106-120.

Buntting, C., Coll, K. R. & Campbell, A. (2006). Student Views of Concept Mapping use in Introductory Tertiary Biology Classes. *International Journal of Science and Mathematics Education, 4,* 641-668.

Burill, G. (2004). The National Council of Teachers of Mathematics Standards.*School Science and Mathematics*, 97(6) 335 – 340.

Busato, V. V., Prins, F. J., Elshout, J, J. & Hamaker, C. (2000).Intellectual Ability, Learning Style, Personality, Achievement Motivation and Academic Success of Psychology Students in Higher Education.*Personality and Individual Differences,* 29(6), 1057-1068.

Bybee, R.W. (2009). *The BSCS 5E Instructional Model and 21st Century Skills:*A Commissioned Paper Prepared for a Workshop on Exploring the Intersection of Science Education and the Development of 21st Century Skills.

Carpusa, J. L. & Lepperb, M. R. (2007). The Effects of Pearson Versus Performance Praise on Children's Motivation: Gender and Age as Moderating Factors. *Educational Psychology,* 27 (4) 487-508.

Carrol, J. A. (1963). *A Model of School Learning*: Teachers School Record 723-733

Case, R. (2005).Moving critical thinking to the main stage.*Education Canada, 45(2),* 45-49.

Catsambis S. (1995). Gender, Race, Ethnicity and Science Education in the Middle Grades. *Journal of Research in Science Teaching*. 32 (2) 243-258.

Cavallo, A. M. L., Potter, W, H. & Rozman, M. (2004). Gender Differences in Learning Constructs, Shifts in Learning Constructs, and their Relationship to Course Achievement in a Structured Inquiry, Yearlong College Physics Course for Life Science Majors. *School Science and Mathematics, 104,* 288-300.

Cavallo, A. M. L., Rozman, M., Blinkenstaff, J. & Walker, N. (2003). Students' Learning Approaches, Reasoning Abilities, Motivational Goals and Epistemological Beliefs in Differing College Science Courses *Journal of College Science Teaching, 33,* 18-23.

Changeiywo, J. S., Wambugu, P. W. & Wachanga, S. W. (2010). Investigations of Students' Motivation Towards Learning Secondary School Physics Through Mastery Learning Approach. *International Journal of Science and Mathematics Education,* 9, 1333-1350.

Chow, S. J. & Yong, B. S. (2013).Secondary School Students Motivation and Achievement in Combine Science.*US-China Educational Review* 3(4) 213-228.

Collazos, C. (2002). Gender: An Influence factor In Collaborative Work Processing Computer-Mediated Communication. Proceedings of the 4th *International Conference on New Educational Environment* (ICNEE 2002). 7-10

Cousin, A. (2015). Gender and High School Chemistry: Students' Perceptions in a Selective Setting. *Cambridge Journal of Education*. 45(2):187-204.

Covington, M. V. (2000). Goal Theory, Motivation and School Achievement: An Integrative Review. *Annual Review of Psychology, 51(2),* 171-200

DeBacker, T. K. &Nelson, R. M. (2000). Motivation to Learn Science: Differences Related to Gender, Class Type And Ability. *Journal of Educational Research, 93(4),* 245-254.

Deci, E. L. & Ryan, R. M. (2008). Facilitating Optimal Motivation and Psychological Well Being Across Life Domains. *Canadian Psychology, 49,* 14-23.

Deci, E. L. & Ryan, R. M. (2009).A meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards in Intrinsic Motivation *Psychological Bulletin* 125 (6) 627-668.

DeLong, M. & Winter, D. (2002). Strategies for Motivating Students.*Learning to Teach and Teaching to Learn Mathematics: Resources for Professional Development* (pp. 159-168). Washington. D. C.: Mathematical Association of America.

Devetak, I., Yogrinc, J. & Glazar, S. A. (2011). Guided Active Learning in Chemistry Modules used in the Profiles Project in Slovenia. In *Book of Abstracts from ESERA 2010,* Lyon, France, 255.

Deweese, S. V. (2012). The Effects of Mastery Learning Correctives on Academic Achievement and Student Affect. Dissertation.Project Mercer University, USA.

DiBennedetto, M. K. & Bembenutty, H. (2011).*Within the Pipeline: Self-Regulated Learning and Academic Among College Students in Science Courses.* Paper presented at American Educational Research Association, New Orleans, Louisiana. Retrieved, from http// files.eric.ed.gov/fulltex/ED518505

Eccles, J. S. & Wigfield, A. (2002).Motivational beliefs, values, and goals.*Annual Review ofPsychology, 53,* 109-132.

Edeh, I. E. & Vikoo, B. (2013). Some Factors Affecting the Performance of Secondary School Students in Chemistry, A Kolokuma/Opokuma Study. *Journal of Education and Practice* 4 (7).Retrieved from http://www.scribd.corn/doc/138847380/

Efe, M. O. (2015). Enhancing Academic Achievement and Retention in Senior Secondary School Chemistry Through Discussion and Lecture Methods: A Case Study of Selected Secondary Schools in Gboko, Benue State, Nigeria. *Journal of Education and Practice 6(21) 151-161.*

Egbo, J. J. (2005). Effects of Concepts Mapping Method Instruction on Students' Achievement and Learning Retention in Chemistry.Unpublished M.Sc Dissertation.Department of Science and Computer Education, (ESUT) Nigeria.

Eisenberg, N. (2010). Self-regulation and school readiness.*Early Education and Development,21(5),* 681-698.

Emily, R. L. (2011). *Motivation: A Literature Review* Retrieved on http://www.pearsonassessment.com/.

Erinosho, S. Y. (2008). *Teaching Science in Secondary School: a Methodology Handbook.* Lagos: African Culture International Centre.

Eze, C. U. (2002). Effects of Target Task Approach on Students" Achievement in Senior School Certificate Inorganic Chemistry.Science Teachers Association of Nigeria.Proceeding of the 43rd Annual Conference 259.

Facione, P. A. (2000). The Disposition toward Critical Thinking: Its Character, Measurement and Relation to Critical Thinking Skill. *Informal Logic,* 20(1), 61-84.

Fatoba, J. O. & Aladejana, A. L. (2014).Effects of Gender on Students' Attitude to Physics in Secondary Schools in Oyo State Nigeria.*European Scientific Journal,* 10 (7) 399-404..

Fatokun, K. V. F. & Odagboyi, I. A. (2010).Gender Disparity and Parental Influence on Secondary School Student's Achievement in Nasarawa State.*Journal of Research in National Development*, 8(2):8-12.

Federal Ministry of Education (F.M.E) (2013).*Senior Secondary School Education Curriculum Chemistry for SS 1-3 Abuja:* Nigerian Educational Research and Development Council (NERDC).

Florence, O. E. (2013).Influence of Concept MAPS on Achievement and Retention of Senior Secondary School Students in organic Chemistry.*Journal of Education and Practice* 4 (19) 35-43.

Fraenkel, J. R. & Wallen, N. E. (2000).*How to Design and Evaluate Research in Educatio*.Retrieved, From https://www.learningthings.com/blog/index.php.

Freedman, M. P. (2002). The Influence Of Laboratory Instruction On Science Achievement and Attitude Towards Science Across Gender Differences. *Journal of Women and Minorities in Science and Engineering,* 8(2), 50-52.

Gambari, A. I. (2004). Effects of computer-assisted instruction package on the performance of senior secondary students in physics in Minna(Unpublished master's thesis).Department of Science and Technical Education, Federal University of Technology, Minna, Nigeria.

Gambari, A. I. (2013). Effectiveness of Video-Based Cooperative Learning Strategy on High, Medium and Low Academic Achievers. The African Symposium: An Online *Journal of the African Educational Research Network*; 13 (2):77-85.

Gambari, I. A. (2016). Promoting Intrinsic and Extrinsic Motivation Among Chemistry Students Using Computer-Assisted Instruction. *Contemporary Education Technology* 7 (11) 25-46.

Garduno, E. L. H. (2001). The Influence of Cooperative Problem Solving on Gender Differences in Achievement, Self-Efficacy and Attitudes Towards Mathematics in Gifted Students. *Gifted Child Quarterly*. 45(4):268-282.

Gbara, T. I. (2013). Effects of Mastery Learning Strategy on Mathematics Performance and Retention of Senior Secondary School Students F.C.T Abuja. Unpublished MEd Thesis, Department of Science Education Ahmadu Bello University Zaria.

Geary, D. C. & Hamson, C. (2007).“Improving the Mathematics and Science Achievement of American Children: Psychology’s Role” Retrieved April 16, 2007 from http://www.apa.org/ed/gerary.html.

Georgina, N. O. & Lessi, T. M. (2015). Effect of Mastery Learning on Senior Secondary School Students Cognitive Learning Outcome in Quantitative Chemistry: *Journal of Education and Practice*. 6 (95), 34-38

Githua, B.N. & Mwangi I.G. (2003). Student Mathematics Self-concept and Motivation to Learn Mathematics: Relationship and Gender Differences Among Kenya’s Secondary School Students in Nairobi and rift Vally Province. *International Journal of Education Development* 23, 487-499.

Glynn, S. M., Taasoobshirazi, G. & Brickman, P. (2007). Non-science majors learning science: A theoretical model of motivation. *Journal of Research in Science Teaching,* 44(8), 1088-1107.

Glynn, S. M., Taasoobshirazi, G. & Brickman, P. (2009). Science Motivation Questionnaire: Construct Validation with Nonscience Majors. *Journal of Research in Science Teaching, 46(2),* 127-146.

Gottfried. A. E. (2001). Continuity of Academic Intrinsic Motivation from Childhood through Late Adolescence: A Longitudinal Study. *Journal of Educational Psychology,* 93(1), 3-13.

Green, V. A. & Rachis, R. (2003). The Effect of Gender Context On Children's Social Behavior in a Limited Resource Situation: An Observational Study. *Social Development,* 12:587-603.

Green, V. A. (2006). Cooperative and Competition Interactions in Limited Resources Situations*:* A Literature Review. *Applied Development Psychology.* 27:42-59.

Guay, F., Chanal, J., Ratelle, C. F., Marsh, H. W., Larose, S. & Boivin, M. (2010).Intrinsic, Identified, and Controlled Types of Motivation for School Subjects in Young Elementary School Children.*British Journal of Educational Psychology, 80(4),* 711-735.

Guskey, T. & Gates, S. (1986). Synthesis of Research on the Effects of Mastery Learning in Elementary and Secondary Classrooms.*Educational Leadership,* 4.8:73-80.

Guskey, T. R. (2007). Closing Achievement Gaps: Revisiting Benjamin S. Bloom's "Learning for Mastery." *Journal of Advanced Academics, 19(1),* 8-31.

Guskey, T. R. & Jung, L. A. (2011).Response-to-Intervention and Mastery Learning: Tracing Roots and Seeking Common Ground. *The Clearing House,*84, 249-255.

Guskey, T. R. (2010). Lessons of Mastery Learning, *Educational Leadership,* 30, 52-57.

Hall, M. (2008).*The Effect of Cooperative Learning Groups and Competitive Strategies on Math Facts Fluency of Boys and Girls*.Retrieved from http// www.coompns.kennesaw.edu/qpc/

Halpern, D. F. (2000).Creating Cooperative Learning Environments.*American Psychological Society Observer.* 13(3): 14-31.

Hanock, D. (2004). Cooperative Learning and Peer Orientation Effects on Motivation and Achievement.*Journal of Educational Research* 97 (3) 159-166.

Hausmann, R., Tyson, L. & Zahidi, S. (2009). *The Global Gender Gap Report.*Switzerland: World Economic Forum, Geneva.

Herrera, T. (2001).An Interviews with Marily Borns Evic focus. *Journal of Educational Research* 8 (92) 16-19.

Hofstein, A. & Mamlok-Naaman, R. (2007). The Laboratory in Science Education: The State of the Art. *Chemistry Education Research and Practice,* 8(2); 105-107.

Hofstein, A., Eilks, J. & Bybce, R. (2011), Societal Issues and Their Importance for Contemporary Science Education; A Pedagogical Justification and the State of the Art in Israel, Germany and the USA.*Int J Sci Math Educ*. Published online first January 4, 2011.Retrieved from http//link.springer.com

Hong, L. H. (2015). Gender and Ethnicity Difference Manifested in Chemistry Achievement and Self-Regidated Learning.*International Education Studies* 2 (2) 53-56.

Hutchison, S. & Smitheman, G. (2002). Cited in "What if you Knew That Some Experts Believe Same Sex School are Better for Minorities". Retrieved April, 2007 from http://www.org/tropical/news/singlesexed/4no-html.

Irorismith, M. &Eppler, M. A. (2007). Faculty Forum: Mastery Learning Benefits Low-Aplitude Students. *Teaching of Psychology,* 34(1), 28-31.

Iweka, S. (2006).Effects of Inquiry and Laboratory Approaches on Teaching Geometry on Students Achievement and Interest.Unpublished M.Ed. Thesis, Department of Education University of Nigeria, Nsukka.

Iyang, N. E. U. & Ekpenyoung, H. E. (2000).Influence of Ability and Gender Groupings on Senior Secondary School Chemistry Students Achievement on Concept of Redox Reactions.*Journal of Science Teachers Association of Nigeria,* 35 (1 &2) 36-42.

Jantur, P. M. (2005). *Professional Development of Chemistry Teachers for the Industrial Development of Nigeria. 46th Science Teachers Association of Nigeria Annual Conference* 210-212. Ibadan HEBN..

Jegede, S. A. (2007). Students' Anxiety towards the Learning of Chemistry in Some Nigeria Secondary SchoolsRetrieved http://'www.adacemicjournals.org/EER.

Jimoh, A. T. (2005). Perception of Difficult Topics in Chemistry Curriculum by Students in Nigeria secondary schools.*Ilorin Journal of Education.*Retrieved at http://www.unilorin.edu.ng/iounials/ediication/ije/aug2005/.

John, K. K., Barchok, H. K. & Ngeno, J. K. (2014).Effects of Cooperative Mastery Learning Approach on Students; Motivation to Learn Chemistry by Gender.*Journal of Education and Practice* 5(8) 92 – 97.

Johnson, J. O. (2007). The Effects of Cooperative and Individualized Instruction on Students.Attitudes and Achievement.*The Journal of Social Psychology* 102, 207-216.

Joint Admissions and Matriculation Board (JAMB) (2013). Unified Tertiary Matriculation Examination Brochure 2013/2014.

Jossey-Bass Mevarech, Z. (1985).The Effects of Cooperative Mastery Learning Strategies on Mathematics Achievement.*Journal of Educational Research,* 78(3), 372-377.

Joyce, A. (2006). *Mastery Learning the Basic Practice Model of Teaching.*Retrieved on http://www.humboldt.Edu/-thal/mastery.html.

Joyti, M. S. & Sorits, M. S. (2014). A Study of the Effectiveness of Mastery Learning Model on Achievement of Pupils of IX Class in Chemistry.*Educational Journal* 3(7) 27-32.

Jurisevic, M., Vrtacnik, M., ICwiatkowski, M. & Gros, N. (2012).The Interplay of Students' Motivational Orientations, their Chemistry Achievements and their Perception of Learning with the Hands-On Approach to Visible Spectrometry.*Chemical Education: Research and Practice, 13,* 237-247.

Kaufman, J., Agars, M., Lopez, M.& Wagner, M. (2008).Examining Creativity in Turkey High Ability Studies.*Journal of California State University, 18(2),* 235-246.

Kazu, Y. I., Kazu, H. & Ozedemir. I., (2005). The Effects of Mastery Learning Model on the Succe of the Students Who Attended "Usage of Information Technologies" Course.*Educational Technology and Society,* 8.4.233-243

Keraro, F. N. Orora.W. & Wachanga, S.W. (2005).Effects of Concept Mapping Teaching Approach on Secondary School Students' Achievement in Biology in Gucha District Kenya. *Journal of Educational Research,* 17(1), 1-18.

Kolawole, E. B. (2007). Effects of Competitive and Cooperative Learning Strategies on Academic Performance of Nigerian Students in Mathematics. *Educational Research Review,* 3(1), 33-37.

Kozochkina, T. L. (2009). Differentiation Among Schools as a Factor of the Quality of General Education. *Russian Education and Society. 51(1), 3-9.*

Krammer, H. (2005). Recurrent difficulties: Solving Quantitative Problems. *Journal of Chemical Education* 59.6:509-512

Kulik, C. C., James, A. K. & Robert, L. B. (2013). Effectiveness of Mastery Learning Programmes: Ameta Analysis. *Review of Educational Research* 60(2) 265-299.

Kwaileh, F. & Zaza, H. (2011). Gender Differences in Academic Performance Among Undergraduates at the University of Jordan: Are they Real or Stereotyping? *College Student Journal,* 45 (3), 633 – 648.

Lau, K. L. & Chan, D. W. (2001). Motivational Characteristics of Under-Achievers in Hong Kong.*Educational Psychology,* 27(4), 417-430..

Lawal, H.A. (2010).A Survey of the Adquacy of Chemistry Laboratory Equipment and its Effect on the Academic Performance of Students in some Secondary Schools in Zaria. An unpublish Project Department of Science Education ABU Zaria.

Lawal, M.O. (2002). Effects of three Instructional Strategies on Cognitive Learning Outcomes of students in Mathematics. An Unpublished MEd Dissertation Department of Science Education, University of Ibadan.

Learning Things LLC (2014).*Teaching Chemistry to Middle School Students*- Huge Selection of School and Homeschool Curriculum. Retrieved from www.learningthing.com/blog/index.php

Linnenbrink, E. A. & Pintrich, P. R. (2002).Motivation as an Enabler for Academic Success.*School Psychology Review, 31(3),* 313-327.

Loofa, J. K. (2001), Sex, Age and Performance in Chemistry.*Instructional Science* 18, 119-147.

Lovat, T. (2003).*The Role of the 'Teacher' Coming of age.*Melbourne; Australian Council of Deans.

Madu, B. C. (2004). Effect of a Constructivist-Based Instructional Model on Students' Conceptual Change and Retention in Physic.Unpublished Ph.D Thesis, Department of Education University of Nigeria, Nsukka.

Mari, J. S. (2001). The Effect of Process Skills Instruction on Formal Reasoning Ability Among Senior Secondary School Students in Kaduna State.

Unpublished PhD Dissertation, Department of Education Ahmadu Bello University, Zaria.

Mari, J. S. (2006). A Guide for Effective Management of Laboratory Resources Towards Enhancing the Teaching/Learning of Science in Secondary Schools. *Journal of Educational Management and Planning*l(l) 175-180.

Mari, J. S. (2012). Gender Related Differences in Acquisition of Formal Reasoning Schemata: Pedagogic Implication of Teaching Chemistry Using Process – Based Approach. *International Journal for Cross-Disciplinary Subjects in Education* 2(2) 993-997.

Martinez, M.E. (2006). What is metacognition? *Phi Delta kappan* 89 (9) 696-699

McCarthy, W. C. & Widanski, B. B. (2009).Assessment of Chemistry Anxiety in a Two Year College.*Journal of Chemical Education,* 5(5(12), 1447-1449.

Moos, D. C. (2010). Nonlinear Technology: Changing the Conception of Extrinsic Motivation? *Computers & Education,* 55(4), 1640-1650.

Muhammad, B. A. (2014). An Evaluation of the Efficacy of Conceptual Instructional Method of Teaching Practical Chemistry: The Case of Secondary Schools in Zaria Educational Zone Kaduna State, Nigeria. *African Journal of Education and Technology*, 4(1), 112-118.

Ngesa, F. U. (2002). Impact of Experiential and Mastery Learning Programmes on Academic Achievement in Secondary School Agriculture.Unpublished Ph.D. thesis, Faculty of Education Egerton University, Kenya.

Nnaka, V. (2008).Responsive of Science Teachers to Gender Issues in the Teaching of Science Subjects.*Focus on Research, Reproductive Health Education and Gender Sensitive Classrooms. Ibadan, Nigeria:School Teachers Association of Nigeria. Gender and STM Education Series No. 2.95-100.*

Nwagbo, C. R. & Chukelu, U. C. (2001).Effects of Practical Activities on Students Process Skill Acquisition.*Journal of Science Teachers Association of Nigeria* 46(1) 58 – 70.

Nwagbo, C. R. & Obiekwe, C. (2010).Effects of Constructivist Instructional Approach on Students Achievement in Basic Ecological Concept in Biology.*JSTAN* 45(1&2) 26 – 35.

Nwagbo, C. R. & Okoro, C. (2012).Effects of Instruction Pattern on Achievement in Biology among Secondary School Students.*Journal of Science Teachers Association of Nigeria*, 47 (1) 22 – 32.

Nwagbo, C. R. (2001.) The Relative Efficacy of Guided Inquiry and Expository Methods on Achievement in Biology Students of Different Levels of Scientific Literacy.*Journal of Science Teachers Association of Nigeria* 36.2:43-51.

Nwoye, A. N. (2012). Assessment of Resources and the Level of Entrepreneurial Skills Acquired by Secondary School Physics Students in Anambra

State.Master's Thesis, Unpublished, Department of Education Akwa: Nnamdi Azikwe University Nigeria

Nzekwe OJ (2013). The Impact of the Implementation of the Nigerian Curriculum initiatives on Secondary School Administrators and Teachers in Enugu State: Graduate Division of Educational Research. PhD Thesis, Unpublished. Calgary University of Calgary.

Obeka, T. (2007).Comparative Effects of Epodewald and Power Simulations Games on Students’ Achievement and Interest in some Environmental Education Concepts in Geography. Unpublished Ph.D Thesis Department of Science Education, Nsukka: University of Nigeria.

Obiekwe, C. (2008). Effect of Construction: Visits Instructional Approach on Students' Achievement and Interest in Basic Ecological Concepts in Biology. Unpublished M.Ed. Thesis, Department of Education University of Nigeria, Nsukka

Oconnor, K. (2001). Investigating the Cognitive Complexity of Science Assessments. *Educational Measurement: Research and Practice* 17 (3) 37-45.

Ogan, S. S. (2012). Effect of Mastery Learning on Senior Secondary School Achievement in Geography.An Unpublished M.Ed Thesis Department of Education University of Ibadan Nigeria.

Ogba, O. (2000). Interactive Effects of Mastery and Locus of Control on Cognitive Learning Outcomes of Junior Secondary School Mathematics.An Unpublished M.Ed Thesis, Department of Education University of Ibadan Nigeria.

Ogunbiyi, O. (2004). New challenges in the Methodologies of Teaching. A *Case of in-Service Programme for School Teachers* in Elaturoti, F and Babarinde K (eds) Teachers' Mandate on Education and Social Development in Nigeria.

Okeke, E. A. (2008). Clarification and Analysis of Gender Concepts.*Focus on Research, Reproductive Health Education and Gender Sensitive Classrooms. Ibadan, Nigeria: School Teachers Association of Nigeria.Gender and STM Education Series No. 2*.5-8.

Okeke, E. A. C. (2007). Making Science Education Accessible to all.*23rd Inaugural Lecture of the University of Nigeria, Nsukka.*327.

Okoro, A. U. (2011). Effect of Interaction Patterns on Achievement and Interest in Biology Among Secondary School Students in Enugu States Nigeria. Unpublished M.Ed. Thesis, Department of Education University of Nigeria, Nsukka.

Olasheinde, K. J. & Olatoye, R, A. (2014). Comparison of Male and Female Senior Secondary School Students' Learning Outcomes in Science in Katsina State, Nigeria.*Mediterranean Journal of Social Sciences*, 5 (2):518-523.

Olorukooba, S. B. (2001). The Relative Effects of Instructional Strategy and Traditional Methods on the Students Performance of Senior Secondary School

Chemistry Students unpublished Ph.D Thesis, Department of Education Ahmadu Bello University Zaria.

Olorukooba, S. B. (2007). *Science, Technology and Mathematics (STM) Education is for all Students: Promoting Effective Teaching of STM Subjects in our Schools Through Teacher Preparation.* Proceedings of the 50th Anniversary Conference of Science Teachers Association of Nigeria.(PP-3-6).

Olorundare, S. A., Oyelekan, S. O. & Lamidi, B. T. (2015).Effect of Mastery Learning Instructional Strategy on Senior Secondary School Students' Achievement in the Mole Concept.*Electronic Journal of Science Education* 19 (5) 1-19.

Oloyede, O. I. & Demide, C. O.(2000). Enhancing Transition From Concrete to Formal Cognitive Functioning for Improved Achievement in Chemistry. *African Journal of Research in Education, 1(2),* 48-58.

Oloyede, O. I. (2010). Enhanced Mastery Learning Strategy on the Achievement and Self Concept in Senior Secondary School Chemistry.*Humanity and Social Sciences Journal* 5(1), 19-24.

Oludipe, D. (2010). Effect of Cooperative Learning Teaching Strategy on the Reduction of Students' Anxiety for Learning Chemistry.*Journal of Turkish Science Education.*7(1):30-36.

Olufunmilayo, I. O. (2010).Enhanced Mastery Learning Strategy on Achievement and Self Concept in Senior Secondary School Chemistry.*Humanity and Social Sciences Journal.* 5.1:19-24.

Omiko, A. (2011). *Evaluation of Chemistry Textbooks in Use in Nigerian, Secondary Schools.*173-186.

Omolade, O. O. (2008). Effects of Lecture Demonstration and Lecture Teaching Methods on Students' Achievement in Secondary School Chemistry.*Journal of Teacher Education*9(10), 175.

Omoniyi, J. A. (2006). Impact of Type of Teacher Training on Students Achievement and Attitude Towards Integrated Science. Unpublished Ph.D. Thesis, Department of Education University of Nigeria, Nsukka.

Onyegegbu, N. (2008). *Gender and Reproductive Health*: The What, the How and the Why, Ibadan, Nigeria: Focus on Research, Reproductive Health Education and Gender Sensitive Classrooms. Ibadan, Nigeria: School Teachers Association of Nigeria. Gender and STM Education Series No, 2.17-28.

Onyegegbu.N. (2004). Interaction And Gender in Senior Secondary School Science Classroom. *Journal of the Nigerian Academy of Education*, 2(1):33-41.

Opara, F. & Peter, W. (2013) Enhancing Students Achieved in Chemistry Through the Piajetian Model: The Learning Cycle. *International Journal for Cross Disciplinary Subjects in Education* 4(4) 1270-1278.

Owuamanan, T. O. & Babatunde, J. O. (2007).Gender-Role Stereotypes and Career Choice of Secondary School Students in Ekiti State. *Journal of Educational Focus* 1(1), 103-110.

Papanastasiou, E. C. (2001). Willingness to Follow Math Related Careers Among Seniors in Math Classes. The Case of Cyprus Manuscript Submitted for Publication. *Science Education International* 13(2) 20-21.

Patricia W.W & Johnson, M.C. (2008). Effects of Mastery Leanring Approach on Secondary School Students Physics Achievement. *Eurasia Journal of Mathematics Science & Technology Education.* 4 (3), 293-302.

Pearson, J. & Michael, R. (2014*). How Three High Schools in Kentucky Implement Mastery Learning.* Washington Boulevard.

Pellegrine, J. W. & Hilton, M. L. (2012).*Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century.*National Research Council, Hewlett Foundation.

Pepple, T. F. (2010). Effects of Cooperative Learning and Programmed Instructional Strategies on Students' Learning Outcomes in Chemistry.An Unpublished PhD Thesis, Department of Science Education Delta State University, Nigeria.

Pepple, T. F. (2014). Effect of Mastery Learning Approach on Secondary School Student Achievement in Chemistry in Rivers State, Nigeria.*Journal of Chemistry and Material Research* 6(a) 104 – 110.

Pinker, R. O. (2003). "*The Blank State: Modern Denial of Human Nature"* Viking: Published by Penguin Group, Review of Research Washington D.C.

Pintrich, P. R. (2003). A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts.*Journal of Educational Psychology,* 95(4), 667-686.

Priest, N., Rudenstine, A., Weisstein, E. & Gerwin, C. (2012).*Making Mastery Work: A Close-Up View of Competency Education.*Quincy, MA: Nellie Mae Foundation.

Reinhardt, C. (2001*). Chemical Sciences in the 20th Century*: *Bridging Boundaries.* Oxford, UK: Wiley-VCH.

Rheinberg, F., Vollmeyer, R. & Rollett, W. (2000).Motivation and Action in Selfregulated Learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of Self-Regulation* (pp. 503-531). San Diego, CA: Academic Press..

Ryan, R.M. & Deci, E.L (2000, Intrinsic and Extrinsic Motivation: Classic Defination and New Directions. *Contemporary Educational Psychology* 25, 54-67.

Salami, C. G. E. (2013).Gender and Academic Achievement of Physics Students in Secondary Schools.*African Research Reviewed*, 4(3) 150-157.

Sambo, A. A. (2005). *Research Methods in Education*. Stirling-Horden Publishers Nigeria, Limited.

Sandra, D. (2002). Mathematics and Science Achievement: Effects of Motivation, Interest and Academic Engagement. *Journal of Educational Research, 95(6),* 323-332.

Schraw, G., Crippen, K. J. & Hartley, K. (2006).Promoting Self-Regulation in Science Education: Metacognition as Part of a Broader Perspective on Learning.*Research in Science Education, 36,* 111-139.

Schunk, D. H. & Zimmerman, B. J. (2008). *Motivation and Self Regulated Learning: Theory, Research, and Applications.* New York, NY: Lawrence Erlbaum.

Simpkins, S. D., Davis-Kean, P. E. & Eccless, J. S. (2006). Mathamatics and Science Motivation: A Longitudinal Examination of the Link Between Choices and Belief. *Development Psychology*, 42, 70 – 83.

Singh, K. M., Granville, S. & Dike, S. (2002). "Mathematics and Science Achievement: Effects of Motivation; Interest and Academic Engagement". Hecdref Publications.Retrieved April 16, 2007 from http://www.access my library.com/comsitest/bin/comsite 5.P.?

Sjoberg, S. (2002). Science and Technology Education in Europe: Current Challenges and Possible Solutions. Connect: *UNESCO International Science, Technical and Environmental Education Newsletter,* 27(3-4), 1-5.

Skaalvik, E. M. & Skaalvik, S. (2006). Self-Concept and Self-Efficacy in Mathematics: Relation withMathematics Motivation and Achievement. Paper presented at the Proceedings of *The International Conference on Learning Sciences,* Bloomington, Indiana.

Skinner B.F. (1984). The Evolution of Behaviour. *Journal of Experimental Analysis of Behaviour* 41, 217-221.

Slavin, R. E. & Karweit, N. L. (1984). Mastery Learning and Student Teams: A Factorial Experiment in Urban General Mathematics Classes. *American Educational Research Journal,* 21 (4), 725-736.

Slavin, R. E. (1987). Mastery Learning Reconsidered. *Review of Educational Research,* 57(2), 175-213.

Sliva, C. (2003). Mastery Learning and Students Teams.A Factorial Experiment in Urban General Mathematics Classes.*American Research* 8 (2) 16-19.

Taasoobshirazi, G. (2007). Gender Differences in Physics: A Focus on Motivation. *Journal of Physics Teacher Education Online, 4(3),* 1-21.

Talib, O., Wong, S. L..Azhar, S. C, & Abdullah, N. (2009).Uncovering Malaysian Students' Motivation to Learning Science.*European Journal of Social Sciences, 8(2),* 266-276.

Theraza, N. (2013). Effects of Gender and Location on Students Achievement in Chemistry Secondary Schools in Nsukka Local Government Area Enugu State Nigeria.*Research on Humanities and social Sciences 34 (15) 50-55*.

Tim, E. A. (2014). Mastery Learning Approach on Secondary Students' Integrated Science Achievement: *British Journal of Education* 2 (7) 80-88.

Tuckman, B.W. (1975). *Measuring Educational Outcomes*. Harcourt brace Mohawics Inc new York.

Uche, J. O. & Ojo, J. O. (2012).*Blooms Mastery Learning Theory: Implications on Adult Education.* Retrived on http://-works.bepress.com/druche.obidieguse/2/

Udoh, O. A. (2008). An Analysis of Classroom Interaction of Senior Secondary School Chemistry Teachers in Ikot Ekpene Local Government Area of Akwa Ibom State Nigeria.*Journal of the Science Teachers Association of Nigeria, 43(1*& 2), 16-22.

Ukozor, F. I. (2011). Effect of Constructivism Teaching Strategy on Senior Secondary School Students' Achievement and Self-Efficacy in Physics.*African Journal of Science Technology and Mathematics Education.*1(1), 141-160.

Usman, I. A. (2000). The Relationship Between Students Performance in Practical Activities and Their Academic Achievements in Basic Science Using NISTEP Mode of Teaching. An Unpublished Ph.D. Dissertation, Dept. of Education, A.B.U., Zaria.

Usman, K. O. & Memeh.O. (2007).Improving Students' Achievement in Further Chemistry Using Team Teaching Approach.*Review of Education,* 18.1:15-21.

ViAnn, E. (2004). Gender Difference and the Effects of Cooperative Learning in College Level Mathematics.Ph.D Thesis.Curtin University of Technology Australia.

Viko, B. C. (2002). The Influence of Cognitive Preferences on Students Academic Achievement in Integrated Science Process Skills at Senior Secondary School Level, Unpublished Ph.D. Thesis, Dept of Education University of Port,Harcourt, Nigeria.

Vugt, V. M. (2007). Gender Differences in Cooperation and Competition: The Male-Warrior Hypothesis. *Psychological Science*: 18(1).

W.A.E.C. (2010).*Chief Examiner's Report.West African School Certificate Examination.*Lagos, Nigeria.

W.A.E.C. (2011).*Chief Examiner's Report.West African School Certificate Examination.*Lagos, Nigeria.

W.A.E.C. (2012).*Chief Examiner's Report.West African School Certificate Examination.*Lagos, Nigeria.

W.A.E.C. (2013). *Chief Examiner's Report.West African School Certificate Examination.*Lagos, Nigeria.

W.A.E.C. (2014).*Chief Examiner's Report.West African School Certificate Examination.*Lagos, Nigeria.

W.A.E.C. (2015). *Chief Examiner's Report.West African School Certificate Examination*. Lagos, Nigeria.

Wachanga, P. W. & Johnson M. C. (2008). Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement.*Eurasia Journal of Mathematics, Science & Technology Education*, 4.3:293-302.

Wachanga, S. W. and Gamba, P. P. (2004).Effects of Mastery Learning Approach on Secondary School Students Achievement in Chemistry in Nakuru District, Kenya.*Egerton Journal Humanities, Social Studies and Education,* 5(2): 221-235.

Wachanga, S. W., Arimba A. M. & Mbogua, K. Z. (2013).Effects of Advanced Organisers Teaching Approach on Senior Secondary Students Achievement in Chemistry in Maorg District Kenya.*Journal of Social Sciences and Inter-Disciplinary Research* 2 96).

Wachanga, S.W. & Mwangi, J. G. (2004).Effects of Cooperative Class Experiment Teaching Method on Secondary School Students' Chemistry Achievement ii Kenya's Nakuru District.*International Educational Journal,* 5(1), 26-36.

Walker, C. O., Greene, B. A. & Mansell, R. A. (2006).Identification with Academics, Intrinsic/Extrinsic Motivation, and Self-Efficacy as Predictors of Cognitive Engagement.*Learning and Individual Differences, 16(1),* 1-12.

Wambugu P.W. & Changeiywo J. M. (2007). Effects of mastery Learning Approach on Secondary School Students' Physics Achievement: *Eurasia Journal of Mathematics Science and Technology Education.* 4 (3) 293-302.

Wambugu, P. W. & Changeiywo, J. M. (2008).Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement.*Eurasia Journal of Mathematics, Science and Technology Education,* 4(3), 293-302.

Wachanga, S. W., Changeiywo, J. M. & Wambagu, P. W.(2010). Investigation of Students' Motivation Towards Learning Secondary School Physics through Mastery Learning Approach: *International journal of Science and Mathematics Education* 9: 1333-1350.

Wambugu, P.W. & Johnson C.M (2007). Effects of Mastery Learning Approach, on Secondary School Students Achievements. *Humanities Social Sciences and Education* 5 (2), 221-235.

Warburton, K. (2003). Deep Learning and Education for Sustainability..*International Journal of Sustainability in Higher education.*4 (10), 44-56.

Watson, M., McSorley, M., Foxcroft, C. & Watson, A. (2004).Exploring the Motivation and Learning Strategies of First Year University Learners.*Tertiary Education and Management,* 10(3), 193 -207.

Willingham, D. T. (2007). Critical Thinking: Why is it so Hard to Teach? *American Educator,* 31(2), 8-19.

Wiseman, D. C. (2002).*Research Strategies for Education*. Wadwarth Publishign Company.

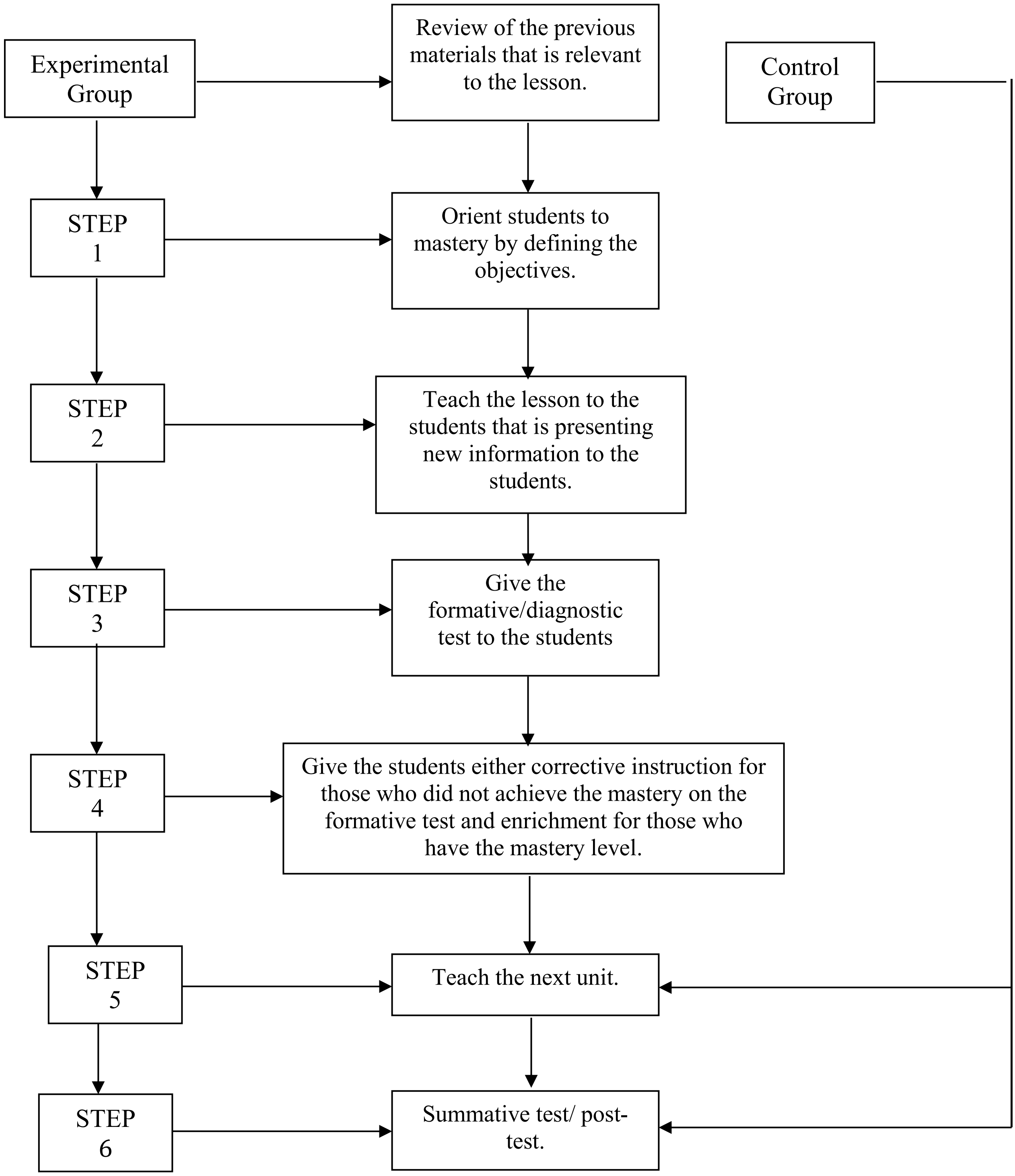
Zeegers, P. (2001). Approaches to Learning in Science: A Longitudinal Study. *British Journal of Educational Psychology,* 71(1), 115-132.

Zhu, Y. &Leung, F. K. S. (2011). Motivation and Achievement: Is there an East Asian Model? *International Journal of Science and Mathematics Education, 9,* 1189-1212.

Zimmerman, B. J. & DiBenedetto, M. K. (2008). Mastery Learning and Assessment: Implications for Students and Teachers in an Era of High-Stakes Testing. *Psychology in the Schools,* 45(3), 206-216.

APPENDIX A

FLOW CHART OF MASTERY LEARNING INSTRUCTIONAL STRATEGY



Source: Adopted from Bloom (1968) in Uche et al. (2012)

APPENDIX B

CHEMISTRY STUDENT PERFORMANCE TEST (CSPT)

School: ……………………………………………………………………………….

Sex: Male: ……………………………………….. Female: …………………………

Age: ………………………… Class: …………………………………………………

Instructions: answer all questions, all questions carry equal marks, circle the correct answer

Time allowed: 1hour

1. The correct value of Avogadro's number is

   (a) 6.02×10^{23}

   (b) 6.02×10^{22}

   (c) 6.62×10^{24}

   (d) 6.02×10^{21}

2. Which of the following statements is correct?

   (a) One gram atom of carbon contains Avogadro's number of atom.

   (b) One mole of oxygen gas contains Avogadro's number of atom

   (c) One mole of electrons stands for 6.02×10^{23} electrons.

   (d) One mol of hydrogen contains Avogadro's number of atom

3. 5.6 litres of oxygen at S.T.P is equivalent of

   (a) 0.25 mole

   (b) 0.125 mole

   (c) 0.5 mole

   (d) 1.0 mole

4. The total number of atoms represented by the compound $CuSO_4.5H_2O$ is

   (a) 27

(b) 5

(c) 21

(d) 8

5. 5 moles of a gas in closed vessel was heated from 300k to 600k; which doubled the pressure of the gas. The number of moles of the gas will be

(a) 20

(b) 2.5

(c) 10

(d) 5

6. 1 mole of a compound contains 1 mole of carbon atom and 2 moles of oxygen atoms. The molecular weight of the compound is,

(a) 3

(b) 12

(c) 32

(d) 44

7. Avogadro's number represents the number of atoms in

(a) 320g of sulphur

(b) 32gof oxygen

(c) 12g of 2C

(d) 127g of 12

8. A symbol not only present the name of the element but also represents

(a) it's atoms no

(b) reactivity

(c) it's atomicity

(d) 1 gm - atom

9. 5.0 litres of 0.4m H_2SO_4 contains

(a) 2.0 mole H_2SO_4

(b) 2.0 mole H_2O

(c) 0.4 Mole H_2SO_4

(d) 5.0 mole H_2SO_4

10. 2 moles of H atoms at S.T.P occupy a volume of

(a) 22.4 litres

(b) 44.8 litres

(c) 2 litres

(d) 11.2 litres

11. 0.224 Litres of H_2 gas at S.T.P is equivalent to

(a) 1 mol

(b) 0.01 mol

(c) 02 x 10^{22} mol

(d) 1g of H_2.

12. 100g $CaCO_3$ is treated with 1litres of 1MHCl, what would be the weight of CO_2 liberated after the completion of the reaction

(a) 33g

(b) 5.5g

(c) 22g

(d) 36g

13. The mass of carbon present in 0.5 mole of $K_4[Fe(CN)_6]$ is

(a) 18g

(b) 1.8g

(c) 3.6g

(d) 36g

14. How many grams are contained in 1 gram - atom of Na?

(a) 1g

(b) 23g

(c) l/23g

(d) 11g

15. Which of the following has the largest number of atoms?

(a) 0.25 mole of Cu

(b) 0.035g of Cu

(c) 0.5g atoms of Cu

(d) 0.03g of Cu

16. 22.4 litres of water vapour at S.T.P. when condensed to water, occupies an approximate volume of

(a) 1.8 litres

(b) 18 litres

(c) $1000cm^3$

(d) $18cm^3$

17. The followings can be used to express mole except.

(a) aggregates

(b) ions

(c) molecules

(d) atoms.

18. The symbol for unit of mole is

(a) m

(b) M

(c) Mol

(d) all the above.

19. The atomic masses of Carbon and Helium are 12g and 4g respectively which of the following is true;

(a) they have the same ions

(b) they have the same molecules

(c) they have the same atoms number

(d) they have the same Avogadro's number of atom (NA)

20. 0.059 mole of $CaCO_3$ is required in an experiment, what mass of the salt needs to be weighed out?

(a) 0.59g

(b) 5.9

(c) 5.9gmol^{-1}

(d) 59g

21. 0.20 mol of compound, containing X and Y with atomic masses of 12g and 1g respectively, has a mass of 3.2g what is molecular mass of compound?

(a) 16g mol^{-1}

(b) 16g

(c) 16gdm^{-3}

(d) 16 moles

22. From question 21, above what is the likely molecular formular

(a) XY

(b) XY_6

(c) X_4Y_6

(d) XY_4

23. Atomic mass of an element is

(a) the actual mass of one atom of the element

(b) the relative mass of one atom of the element

(c) the average relative mass of different atoms of the element

(d) may be different from the mass number of the element.

24. The number of moles of CO_2 which contains 8g of oxygen is

(a) 0.256 mol

(b) 0.5

(c) 0.20 mol

(d) 0.40 mol

25. 56 gram of Fe is equivalent to?

(a) 1 mole

(b) 23 mole

(c) 13 mole

(d) 11 mole

26. 1g is equal to

(a) 12g of C_{12}

(b) 14g of O_{16}

(c) 1g of H_2

(d) 1.66×10^{23}kg

27. One mole of oxygen gas is the volume of

(a) 1 Litre of oxygen at S.T.P

(b) 16 litres of oxygen at S.T.P

(c) 22.4 litres of oxygen at S.T.P

(d) 6.02 x 10^{23} molecules of oxygen at any tempt and pressure.

28. Which of the following contains the greatest number of molecules?

(a) 1 Mole of O_2

(b) 1 Mole of Cl_2

(c) 2 Moles of H_2

(d) All of the above

29. Which of the following contains the greatest number of oxygen atoms?

(a) 1g of O_2

(b) 1g of O

(c) 1g of O_3

(d) all of the above

30. Which of the following has the highest mass?

(a) 3.011 x 10^{23}

(b) ½mole of CH_4

(c) 1g atoms of C

(d) $10cm^3$ of water.

31. 48.5gof $CaCO_3$ will be how many moles

(a) 0.485mol

(b) 88mol

(c) 100mol

(d) 0.30mol

32. 22.4 litres of gas at S.T.P weights 28g. The gas could be.

(a) Co

(b) B_2H_4

(c) N_2O

(d) N_2

33. The total number of ions present in 111g of $CaCl_2$ is

(a) One mole

(b) Three Moles

(c) Four moles

(d) Two moles.

34. Which has maximum number of atoms, when X=12, Y=108, Z=27and Q=56?

(a) 24g of X

(b) 108g of Y

(c) 27g of Z

(d) 56g of Q

35. The maximum number of molecules is present in

(a) 15L of H_2 gas at S.T.P

(b) 0.5g of H_2 gas

(c) 10moles of O_2 gas

(d) 5L of N_2 gas at S.T.P

36. 1 mole of electrons is equal to

(a) One neutron

(b) 12g carbon

(c) 6.022×10^{23} electrons

(d) 6.022×10^{23} atoms.

37. What is the amount in moles of 0.5 NaOH in $500cm^3$

(a) 0.25mol

(b) 0.65mol

(c) 0.35mol

(d) 0.45mol

38. 2.00moles of $Ca(OH)_2$ would equal grams.

(a)148g

(b) 74g

(c) 74.8g

(d) 47g.

39. Helium (4g) and Hydrogen (1g) have

(a) same weight

(b) same atomic number

(c) same molecules

(d) same atoms

40. 1 mole H and 1 mole H_2 means

(a) One mole of hydrogen

(b) one mole of hydrogen molecule and one mole of hydrogen atom

(c) One mole of hydrogen atom and one mole of hydrogen molecule

(d) none of the above.

APPENDIX C

CHEMISTRY STUDENT PERFORMANCE TEST (CSPT) MARKING SCHEME

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

APPENDIX D

STUDENTS' MOTIVATION QUESTIONNAIRE

School: …………………………………………………………………………………

Sex: Male: ………………………… Female: ………………………………………..

Age: ……………………………………Class: ………………………………………

Below is a list of items made to investigate the effect of mastery learning instructional strategy ofstudents motivation towards learning ofChemistry. You are requested to rate yourself to indicate the degree to which the items are representative of you. Be as sincere as possible in your rating. This examinationhas nothing to do with your result. All information you will provide will be regarded as hightly confidential and will be treated as such.

INSTRUCTION: Please tell me what you really think by putting a mark (√) in the corresponding box below:

SA = Strongly Agree

A = Agree

DA = Disagree

SD = Strongly Disagree

Learning Chemistry using Mastery Learning Instructional Strategy has:

SN	**Statement**	**SA**	**A**	**DA**	**SD**
1.	Made me love chemistry				
2.	Made learning chemistry frustrating				
3.	Been dull and boring				
4.	Made chemistry enjoyable				
5.	Highly motivate me to work hard in chemistry				
6.	Helped me to discover skills in chemistry				

After learning chemistry using mastery learning instructional strategy

SN	Statement	SA	A	DA	SD
7.	I find it hard to work inadequately				
8.	I expect to rarely be able to apply chemistry in life situations				
9.	I do not expect to be successful in chemistry tasks given by chemistry teachers in the classrooms				
10.	I am now acquiring further knowledge of chemistry				
11.	I can now study and solve problems in chemistry on my own				
12.	I expect to perform well in other science subjects				
13.	I am able to work independently in chemistry exercises in and outside chemistry classrooms.				
14.	I expect to be score highly in chemistry tests				
15.	I expect to be able to apply chemistry easily in other situations in life				
16.	I find learning chemistry is in itself rewarding				
17.	I am now satisfied with the way I learn chemistry				
18.	I no longer feel uneasy during chemistry lessons				
19.	I am dissatisfied with my participation in classroom chemistry activities				
20.	I was satisfied with the way chemistry was taught in the classroom				
21.	I am now satisfied with my performance in chemistry assignments and tests.				
22.	I now aspire to study chemistry after S.S.C.E.				
23.	I am not sure whether I have the desire to continue studying chemistry				
24.	I now find activities in chemistry lessons meaningful				
25.	I discover that chemistry subject matter is related to my daily experiences.				
26.	I realize that chemistry gives opportunities for choice, responsibility and inter-personal influence.				
27.	Chemistry lessons give me opportunities for cooperation and social interactions.				
28.	I would like a career that does not required chemistry				

Source: Adapted from Wachanga et al (2010)

APPENDIX E

LESSON PLAN I

The Experiment Group (Mastery Learning Instructional Strategy)

School: GSS, Karaye/ GGSS Karaye

Date: Monday

Time: 8:00-8:45am

Duration: 45mins

Subject: Chemistry

Topic: Definition of the Mole

Class: S.S. II

Number of Students:

Instructional Material:

Grains of Millet, Maize, Guinea corn etc.

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson using mastery learning instructional strategy the students should be able to;
    i. Define a mole as an entity,
    ii. Identify entity (mole) of different atoms.

b. Entry Behaviour

    Students have already learnt the definition of elements of the periodic table.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development:

Introduction:The teacher will introduce the lesson by asking the students to put some few grains of the millet, maize, rice etc on their palms and ask them to predict how many each has.

The teacher will ask the students to can think of the words that stand for a set of things. The teacher will give example of a pair and a dozen as a set containing 2 and 12 respectively. Further explanations will be made, as dozen of maize and millet are refers as such, but it should be noted that both are equal in quantity, however, each have different particles. i.e. millet contain millet yet a dozen, the Maize has maize particles. A dozen of nails and a dozen of bucket, which have more?

At this stage the teacher will take the students to the context of chemistry. Students will be told that atoms of the element are of different sizes. Furthermore, the teacher will list some of the symbol representing certain atoms such as H^1, He^4, O^{16}, N^{14}, Na^{23}, Ca^{40}, etc For Hydrogen, Helium, Oxygen, Nitrogen, Sodium, and Calcium respectively. The students will be told that, a dozen is always l2 of something ,such as eggs, stone, bucket, cars trains, etc in the same vain, a mole of a substance is the SI unit for amount of a substance that contain the same number of entities as there are atoms in exactly 12g of carbon-12.

Explanation on the various atoms will be explain as follows;

1 mole of Hydrogen (H) = 1g

1 mole of Helium (He) = 4g

1 mole of Nitrogen (N) = 14g

1 mole of Oxygen (O) = l6g

1 mole of Sodium (Na) = 23g

1 mole of Calcium (Ca) = 40g

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

Examples;

1. What is a mole of a substance?
2. Using relevant example, explain how a mole of different substances are related?

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test (70% to above) will given enrichment instruction and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN 2

The Experiment Group (Mastery Learning Instructional Strategy)

Schools: GSS, Karaye/ GGSS, Karaye

Date:

Time: 8:00 – 9.20am

Duration: 45minutes

Subject: Chemistry

Topic: Avogadro's Numberand Mole Concept Relationship in a Reaction.

Class: S.S. II

Number of Students:

Instructional Material.

Grains of Millet, Maize, Guinea corn, rice, tins etc.

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson students should be able to

i. State the Avogadro's number

ii. Explain Avogadro's number in relation to a mole of different atoms.

iii. Write the value of Avogrado's number correctly.

b. Entry Behaviour

Students are familier with definition of a mole.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development:

Introduction:

The teacher will introduce lesson asking the students to count out dozen of Rice, maize and tins (peak).

The students will be ask to compare the various dozen, which of them is larger?

From the response(s) of the students explanation will give on the question asked. How many pieces of each make a dozen? The teacher goes further to explain that a dozen of both tin and maize are equal. That is they contain 12 pieces in each case. Other comparison are made. That each dozen containing equal number and can compared to molecules, atoms, ions and electrons. Each dozen is regarded as a mole. Explanation using various example will be given.

Furthermore, the teacher will explain just as a dozen is always 12 of something, a mole, contain quantity of extremely small particles that exist on a molecular level such as atoms and molecule.

A mole of a substance is equal in value to 6.02 x 10^{23}(602,000 000 000 000 000 000 000). This number is called the Avogadro's number, it is the number of units in a mole. It is given by a symbol (NA).

NA = 6.02 x 10^{23}. Further illustrations on Avogadro's number will be made. Avogadro's number represents the number of atoms of an element in a sample whose mass in gram is numerically equal to the atomic mass of the element. For example:

6.02 x 10^{23} H atoms	=	1g of H.
6.02 x 10^{23} He	=	4g of He.
6.02 x 10^{23} S	=	32g of S.

Relating Avogadro's number to mole.

1 mole of H atom	=	6.02 x 10^{23}
1 mole of O atom	=	6.02 x 10^{23}
1 mole of H_2 molecule	=	6.02 x 10^{23}
1 mole of H_2O molecule	=	6.02 x 10^{23}
1 mole of electron	=	6.02 x 10^{23}

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

i. How many particles are there in a mole?
ii. Write the value of Avogadro's number of the following mole of atoms: Na, Cl, Mg and Ca.

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test (70% to above) will given enrichment instructions and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN 3

The Experimental Group(Mastery Learning Instructional Strategy)

Schools: GSS, Karaye/ GGSS, Karaye

Date:

Time: 8:00 – 9:20am

Duration: 45minutes

Subject: Chemistry

Topic: Calculations involving mole and Avogadro's number.

Class: S.S. II

Number of Students:

Instructional Material.

Periodic table of element and their symbols.

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson students should be able to.
   i. Explain the difference between atomic and molar masses.
   ii. Write and calaculate atomic and molar masses of an element.

b. Entry Behaviour

Students have learnt mole and Avogadro's number.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development

Introduction:

The teacher introduces the lesson by explaining in detail what atomic and mass numbers are. Relating it to the number of electrons, protons and neutrons.

The symbol of some atoms such as Boron B (11), Oxygen O (16), Sulphur S (32).Iron Fe (56), Calcium Ca (40). Will be used to explain relationship of their masses to mole and Avogadro's number.Compounds such as H_2O, HCI, NaCl, $CaCO_3$, H_2SO_4, $KMnO_4$, K_2CrO_4 and NaOH, etc. will be in calculating molecular masses of various compounds or molecules. Example $CaCO_3$

Ca	1 x 40g	=	40g
C	1 x 12g	=	12g
3O	3 x 16g	=	48g
	Total	=	100g.

1 mole $CaCO_3$ = 100g

0.5 mole $CaCO_3$ = 0.5~~mol~~ x 100g = 50g.$CaCO_3$.

1~~mol~~

The teacher explain that each molecular formula with molar mass is representing 1 mole (mol) of the compound example;

1 mole NaCl = 58.5g

1 mole HCl = 36.5g

1 mole K_2CrO_4 = 194g.

In addition, the mole will be explain in relation to Avogadro's number and molecular mass as follows to the students;

1 mole NaCl = 58.5g = 6.02×10^{23}.

1 mole HCl = 36.5g = 6.02×10^{23}.

1 mole K_2CrO_4 = 194g = 6.02×10^{23}.

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

i. How many moles are present in 6.07g of CH_4? Leave the answer in significant figures.

ii. Calculate the molar mass of Na_2CO_3, in 0.2mol.

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test (70% to above) will given enrichment instructions and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN 4

The Experiment Group(Mastery Learning Instructional Strategy)

Schools: GSS, Karaye/ GGSS, Karaye

Date:

Time: 8:45am

Duration: 45 minutes

Subject: Chemistry

Topic: Determination of molar concentration of a solution.

Class: S.S. II

Number of Students:

Instructional Material.

Volumetric flask of different sizes, periodic table of the elements and their symbols.

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson students should be able to

i. Define the term molar concentration,

ii. Solve different problems relatingto molar concentrations.

b. Entry Behaviour

Students have learnt about definition of standard solution.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development

Introduction:

The teacher will introduce the lesson by explaining to the students how a cup of tea is prepared, certain amount of tea-spoon full of sugar is added to different cups of varying sizes to test. There molar concentration is liked to "sweetness" of a solution.

Using $1000cm^3$/litre as the volume. Students will shown how one (1) molar solution is formed. Explanation would given on amount of solute that is dissolved in a given volume of solvent (solution) as molar concentration.

$$\text{Molar concentration} = \frac{\text{moles of solute}}{\text{volume of solution}}$$

Molar concentration of a compound is one which contains one mole or the molar mass of the compound in one dm^3 of the solution. The molar masses for example of sodium hydroxide (NaOH) and potassium hydroxide (KOH) are 40g and 56g respectively. Therefore, a molar solution of NaOH contain 1 mole or 40g of NaOH in 1dm^3 of the solution, while a molar solution of potassium hydroxide contains 1 mole or 56g of the hydroxide in 1dm^3 of the solution.

Molar concentration can be used to calculated;

i. the number of moles of solute in a given volume of solution

ii. the volume of solution containing a given number of moles of solute.

The teacher will explain how a given volume can be use to prepare a 1M solution. It is known that 1M = 1litre = 1000cm^3. Then to prepare 1M NaCl solution, weigh about 40g of the salt and dissolve in 1000cm^3 solution. This solution is containing 1mole of NaCl. Meaning that, it has in solution 1mole which contains 40g of NaCl. Students will be shown 1M, 0.5M, 0.1M 0.02M and many more solutions can be prepared for various compounds. The expression 1M, 0.5M are referring to the amount in moles contain in 1000cm^3/1litre of solution.

NaCl/NaOH would be used to prepare a molar solution.

The teacher will solve some problem to students such as;

A dilute solution of trioxonitrate V acid contains 6.0mol of the acid per litre. It means that 6.0M = 6 x mass number

$$6.0M = 6 \times 63g = 378g$$

$$1.0M = \frac{1\not{M}}{6.0\not{M}} \times 378g = 63g \text{ per one(1)M}$$

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

i. Calculatethe amount of the salt in 25.00cm^3 moles of 1M solution of NaOH.

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test (70% to above) will given enrichment instrction and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN 5

The Experiment Group(Mastery Learning Instructional Strategy)

Schools: GSS, Karaye/ GGSS, Karaye

Date:

Time: 8:00 – 9:20am

Duration: 45minutes

Subject: Chemistry

Topic: Volume-Amount Relationsip in Gases using Avogadros' law.

Class: S.S. II

Number of Students:

Instructional Material.

Balloons of different sizes and colours.

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson students should be able to

i. State Avogadro's law.

ii. Explain that a mole of any gas at STP occupies 22.4dm^3 of volume.

iii. Write the mathematical expression of Avogadro's law.

b. Entry Behaviour

Students have learnt about gases in Boyle and Charles's laws.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development

Introduction:

The teacher will introduce the lesson by explaining to the students that, like atoms and molecular substances, gaseous (gases) too have molecules.

The teacher takes the students to Avogadro's law by stating as follows:

Avogadro's hypothesis state that, at the same temperature and pressure, equal volume of different gases contain the same number of molecules, (or atoms if the gas is mono atomic). It follows that the volume of any given gas must be proportional to the number of molecules present.

That is:

n = number of moles

K_A = is proportionality constant

V α n

$V = K_A n$

The teacher will further explain that "at constant pressure and temperature, the volume of a gas is directly proportional to the number of moles of the gas present". This implies that as n (amount in moles) increases, V (volume in litre/cm^3) increases, and vice versa.

$V = K_A n$

$\frac{V}{n} = K_A$ or V = constant x n

The constant is the same for all gases at a given temperature and pressure, that is Avogadro's law.

Using different gases the relationship between volume and amount will be explained as follows;

Name	Pressure	Temperature	Volume	Number of Particle	Mass
Helium (He)	1 atm	0°C (273K)	22.4dm^3	6.02 x 10^{23}	4.003g
Nitrogen (N_2)	1 atm	0°C (273K)	22.4dm^3	6.02 x 10^{23}	28.02g
Oxygen (O_2)	1 atm	0°C (273K)	22.4dm^3	6.02 x 10^{23}	32.00g

It can be seen that, 1 mole of gas occupies 22.4dm^3.

It is at standard temperature and pressure (STP).

Mass of the gas sample depends on the molar mass of the substance.

It will be stated, one mole of any gas at STP conditions, occupies 22.4dm^3 of volume. Given 4g of Helium it implies 1mole of helium. Since it is one mole of helium, that contains 6.02 x 10^{23} molecules of helium gas, which will make up 22.4dm^3 of volume. This large volume will be fully occupied if the temperature is 0°C at pressure of 1 atmosphere. Any change in temperature/pressure will change the volume occupied by the gas.

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

a. Given that 1moles of hydrogen fluoride is equal to 6.02 x 10^{23}Calculateamount in 4.2moles of the gas.

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test

(70% to above) will given enrichment instruction and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN 6

The Experiment Group(Mastery learning Instructional Strategy)

Schools: GSS, Karaye/ GGSS, Karaye

Date:

Time: 8:00 – 9:20am

Duration: 45minutes

Subject: Chemistry

Topic: Mole Ratio and Mass Relationship in a Reaction.

Class: S.S. II

Number of Students:

Instructional Material. Ababio text book

STEP 1: The teacher introduces the lesson objectives in respect to mastery learning to the students as follows;

a. Behavioural Objective: By the end of the lesson students should be able to

i. Write and balanace some equation involving different chemical reactions relating to mole of different compounds.

ii. Define and write coefficient as use in mole concept.

b. Entry Behaviour

Students are familier with balancing of equation in their SSI.

STEP 2: The teacher present the lesson to the students using the following procedure;

Content Development

Introduction:

The lesson will be introduced to students by writing a simple unbalanced equation. Such as

$NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$ unbalanced

The unbalanced equation will be balanced, to be able to explain that a balance equation is that which contain equal numbers of atoms on reactant and product sides. E.g.

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$.balanced

From the above equation, two moles sodium hydroxide reacted with one mole of tetraoxosulphate VI acid, it implies that the mole ratio is 2:1 for NaOH to H_2SO_4 respectively. Explanation will be given to the students that 2:1 is regarded, as coefficient, which determine the number of moles of substance taking part in that given reaction. Coefficient refer to the number preceding an atom, molecule and molecular formula in a given equation of a reaction examples include the following;

$2H_2 + O_2 \longrightarrow 2H_2O$

$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$

Using number of moles of reacting substances in calculations, that is mole concept. Explanation will be offered on solving such problem as follows. We can calaculate the volume of gases from a balanced chemical equation, provided that the gases are under the same conditions of temeperature and pressure. The coefficients of gaseous reactants and products in a balanced equation give the mole relations as well as volume relations among the gases for example:

$4NH_3(s) + 5SO_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$

4 vol : 5 vol : 4 vol : 6 vol

4 mol : 5 mol : 4 mol : 6 mol

4 volume of ammonia reaction with 5 volume of oxygen to yield 4 volume of nitrogen (ii) oxide and 6 volume of water vapour. Hence one mole of any gas at STP molar volumes occupies $22.4dm^3$. Thus we can calaculate the volumes, masses, moles and number of molecules of gaseous reactants and productsfrom a balanced chemical reactions.

Examples:

In the industrial preparation of hydrogen trioxonitrate (v) acid, ammonia has NH_3, is burn in oxygen in the presence of catalyst according to the following equations.

$4NH_3(g) + 5O_2(s) \longrightarrow 4NO(g) + 6H_2O(g)$

If $260cm^3$ of NH_3 are burn completely; what a volume of (a) O_2 is used up? (b) NO is produced.

Answer

Equation for the reaction.

$4NH_3(g)$	+	$5O_2(g) \longrightarrow$	$4NO(g)$	+	$6H_2O(g)$
4 vol	:	5 vol	:	4 vol	:	6 vol
1 mol	:	5/4 mol	:	4/4 mol	:	6/4 mol

$260cm^3$ of NH_3 will use up $5/4 \times 260cm^3 = 325cm^3$ O_2

$260cm^3$ of NH_3 will use up $4/4 \times 260cm^3 = 325cm^3$ NO

STEP 3: The teacher at this step will give the students a formative test questions to answer to determine the level of their mastery of the unit taught.

Write and complete the equation for the following reactions by indicating the reactants and products mole ratio:

i. $Na_2CO_3 + H_2S0_4 \longrightarrow ?$

ii. $HNO_3 + CuSO_4 \longrightarrow ?$

STEP 4: The teacher collected the test/script of the formative test from the students, the scripts were marked, scored, and returned to the students for corrections and enrichment. The students who have attained the mastery level based on formative test (70% to above) will given enrichment instruction and those who did not attain the mastery (below 70% of the formative test) will be given remedial instruction by the teacher.

STEP 5: The students have achieved the level of mastery and therefore they move to the next lesson.

LESSON PLAN I

The Control Group (Lecture Method)

School: GSS, Zarewa / GGSC, Karaye

Date:

Time: 8:00-8:45am

Monday

Duration: 45mints s

Subject: Chemistry

Topic: Defination of a mole

Class: S.S. II

Number of Students:

Instructional Material:

Grains of Millet, Maize, Guinea corn etc.

Behavioural Objective: By the end of the lesson using lecturer method, students should be able to;.

i. Define a mole as an entity
ii. Identify mole of different atoms.

Entry Behaviour

Students have some already learnt the definition of elements of the periodic table.

Introduction:

The teacher will introduce the lesson by asking the students to put some a few grains of the millet, maize, rice etc on their palms and then to predict how many each has.

Presentation: The teacher will present the lesson to the students. As follows:

Step I

The teacher will ask the students to think of the words that stand for a set of things. The teacher will give example of a pair and a dozen as a set containing 2 and 12 respectively.

Step II

Further explanations will be made, as dozen of maize and millet are refers as such, but it should be noted that both are equal in quantity, however, each have different particles. i.e. millet contain millet yet a dozen, the Maize has maize particles. A dozen of nails and a dozen of bucket, which have more?

Step III

At this stage the teacher will take the students to the context of chemistry. Students will be told that atoms of the elements are of different sizes. Furthermore, teacher will list some of the symbol representing certain atoms such as H^1, He^4, O^{16}, N^{14}, Na^{23}, Ca^{40}, etc For Hydrogen, Helium, Oxygen, Nitrogen, Sodium, and Calcium respectively.

Step IV

The students will be told that, a dozen is always l2 of something ,such as eggs, stone, bucket, cars trains, etc in the vain, a mole is the SI unit for amount of a substance that contain the same number of entities as There are atoms in exactly 12g of carbon-12.

Step V

Explanation on the various atoms will be proved as follows;

1 mole of Hydrogen (H) = 1g

1 mole of Helium (He) = 4g

1 mole of Nitrogen (N) = 14g

1 mole of Oxygen (O) = l6g

1 mole of Sodium (Na) = 23g

1 mole of Calcium (Ca) = 40g

Evaluation: The lesson will be evaluated by the teacher as follows;

1. What is a mole of a substance?
2. Using relevant example, explain how a mole of different substances are related.

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give the students note to copy on the chalkboard.

LESSON PLAN 2

The Control Group (Lecture Method)

Schools: GSS, Zarewa/ GGSC, Karaye

Date:

Time:

Duration: 45minutes

Subject: Chemistry

Topic: Avogadro's Number and Mole Concept Relationship in a Reaction.

Class: S.S. II

Number of Students:

Instructional Material.

Grains of Millet, Maize, Guinea corn, rice, tins etc.

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

i. State the Avogadro's number

ii. Explain Avogadro's number in relation to a mole of different atoms.

Entry Behaviour

Students have some knowledge about mole of a substance.

Introduction

The teacher will introduce lesson asking the students to count out dozen of Rice, maize and tins (peak).

Presentation: The students will be ask to compare the various dozen, which of them is larger?

Step I

From the response(s) of the students explanation will give on the question asked. How many pieces of each make a dozen? The teacher goes further to explain that a dozen of both tin and maize are equal. That is they contain 12 pieces in each case. Other comparison are made.

Step II

That each dozen containing equal number and can compared to molecules, atoms, ions and electrons. Each dozen is regarded as a mole. Explanation using various example will be given.

Step III

Furthermore, the teacher will explain just as a dozen is always 12 of something, a mole, contain quantity of extremely small particles that exist on a molecular level such as atoms and molecule.

A mole of a substance is equal in value to 6.02 x 10^{23}(602,000 000 000 000 000 000 000). This number is called the Avogadro's number, it is the number of units in a mole. It is given by a symbol (NA).

Hence, NA = 6.02 x 10^{23}.

Step IV

Further illustrations on Avogadro's number will be made. Avogadro's number represents the number of atoms of an element in a sample whose mass in gram is numerically equal to the atomic mass of the element. For example;

6.02 x 10^{23} H atoms = 1g of H.

6.02 x 10^{23} He = 4g of He.

6.02 x 10^{23} S = 32g of S.

Relating Avogadro's number to mole.

1 mole of H atom = 6.02 x 10^{23}

1 mole of O atom = 6.02 x 10^{23}

1 mole of H_2 molecule = 6.02 x 10^{23}

1 mole of H_2O molecule = 6.02 x 10^{23}

1 mole of electron = 6.02 x 10^{23}

Evaluation

The teacher evaluates the lesson as follows:

i. How many particles are there in a mole?

ii. Write the value of Avogadro's number of the following mole of atoms; Na, Cl, Mg and Ca.

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give them note to copy on the chalkboard.

LESSON PLAN 3

The Control Group (Lecture Method)

Schools: GSS, Zarewa / GGSC, Karaye

Date:

Time:

Duration: 45minutes

Subject: Chemistry

Topic: Calculation involving mole and Avogadro's number.

Class: S.S. II

Number of Students:

Instructional Material.

Periodic table of element and their symbols.

Behavioural Objective: By the end of the lesson students should be able to know.

i. Explain the difference between atomic and molar masses.

ii. Write and calaculate atomic and molar masses of the elements.

Entry Behaviour

Students have learnt mole and Avogadro's number.

Introduction

The teacher introduces the lesson by explaining in detail what atomic and mass numbers are. Relating it to the number of electrons, protons and neutrons.

Step I

The symbol of some atoms such as Boron B (11), Oxygen O (16), Sulphur S (32).Iron Fe (56), Calcium Ca (40). Will be used to explain relationship of their masses to mole and Avogadro's number.

Step II

Compounds such as H_2O, HCI, NaCl, $CaCO_3$, H_2SO_4, $KMnO_4$, K_2CrO_4 and NaOH, etc. will be in calculating molecular masses of various compounds or molecules. Example $CaCO_3$

Ca	1 x 40g	=	40g
C	1 x 12g	=	12g
3O	3 x 16g	=	48g
Total	=	100g.	

1 mole $CaCO_3$ = 100g

0.5 mole $CaCO_3$ = 0.5~~mol~~ x 100g = 50g.$CaCO_3$.

1~~mol~~

Step III

The teacher explain that each molecular formula with molar mass is representing 1 mole (mol) of the compound such that;

1 mole NaCl = 58.5g

1 mole HCl = 36.5g

1 mole K_2CrO_4 = 194g.

Step IV

In addition, the mole will be explain in relation to Avogadro's number and molecular mass to the students as follows;

1 mole NaCl	=	58.5g	=	6.02×10^{23}.
1 mole HCl	=	36.5g	=	6.02×10^{23}.
1 mole K_2CrO_4	=	194g	=	6.02×10^{23}.

Evaluation

The teacher evaluates the lesson as follows:

How many moles are present in 6.07g of CH_4? Leave the answer in significant figures.

Calculate the molar mass of Na_2CO_3, in 0.2mol.

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give them note to copy on the chalkboard.

LESSON PLAN 4

The Control Group (Lecture Method)

Schools: GSS, Zarewa / GGSC, Karaye

Date:

Time:

Duration: 45 minutes

Subject: Chemistry

Topic: Determination of molar concentration.

Class: S.S. II

Number of Students:

Instructional Material.

Volumetric flask of different sizes, periodic table of the elements and their symbols.

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

i. Define the term molar concentration
ii. Carry out some calculations involving molar concentrations.

Entry Behaviour

Students have learnt about definition of a standard solution.

Introduction

The teacher will introduce the lesson by explaining to the students when a cup of tea is to be prepare, certain amount of tea-spoon full of sugar is added to different cups of varying sizes to test. There molar concentration is liked to "sweetness" of a solution.

Presentation: the lesson is presented in the following ways;

Step I

Using $1000cm^3$/litre as the volume. Students will shown how one (1) molar solution is formed. Explanation would given on amount of solute that is dissolved in a given volume of solvent (solution).

$$\text{Molar concentration} = \frac{\text{moles of solute}}{\text{volume of solution}}$$

Molar concentration of a compound is one which contains one mole or the molar mass of the compound in one dm^3 of the solution. The molar masses for example of sodium hydroxide ($NaOH$) and potassium hydroxide (KOH) are 40g and 56g respectively. Therefore, a molar solution of $NaOH$ contain 1 mole or 40g of

NaOH in 1dm^3 of the solution, while a molar solution of potassium hydroxide contains 1 mole or 56g of the hydroxide in 1dm^3 of the solution.

Molar concentration can be used to calculated;

iii. the number of moles of solute in a given volume of solution

iv. the volume of solution containing a given number of moles of solute.

Step II

The teacher will explain how a given volume can be use to prepare a 1M solution. It is known that 1M = 1litre = 1000cm^3. Then to prepare 1M NaCl solution, weigh about 40g of the salt and dissolve in 1000cm^3 solution. This solution is containing 1mole of NaCl. Meaning that it has in solution 1mole which contains 40g of NaCl.

Step III

Students will be shown 1M, 0.5M, 0.1M 0.02M and many more solutions can be prepared for various compounds. The expression 1M, 0.5M are referring to the amount in moles contain in 1000cm^3/1litre of solution.

NaCl/NaOH would be used to prepare a molar solution.

Step IV

A problem such as;

A dilute solution of trioxonitrate V acid contains 6.0mol of the acid per litre. It means that 6.0M = 6 x mass number

6.0M = 6 x 63g = 378g

1.0M = $\frac{1\cancel{M} \times 378g}{6.0\cancel{M}}$ = 63g per one(1)M

Evaluation

The lesson will be evaluated as follows

Calculate the amount of the salt in 25.00cm^3 moles of 1M solution NaOH.

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give them note to copy on the chalkboard.

LESSON PLAN 5

The Control Group (Lecture Method)

Schools: GSS, Zarewa / GGSC, Karaye

Date:

Time:

Duration: 45minutes

Subject: Chemistry

Topic: Volume-Amount Relationsip in Gases using Avogadros' law.

Class: S.S. II

Number of Students:

Instructional Material.

Balloons of different sizes and colours.

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

i. State Avogadro's law.
ii. Explain that a mole of any gas at STP occupies 22.4dm^3 of volume.
iii. Write the mathematical expression of Avogadro's number.

Entry Behaviour

Students have learnt about gases in Boyle and Charles's laws.

Introduction

The teacher will introduce the lesson by explaining to the students that, like atoms and molecular substances, gaseous (gases) too have molecules.

Step I

Avogadro's hypothesis stating that at the same temperature and pressure, equal volume of different gases contain the same number of molecules (or atoms if the gas is mono atomic). It follows that the volume of any given gas must be proportional to the number of molecules present.

That is,

n = number of moles

K_A = is proportionality constant

$V \alpha n$

$V = K_A n$

Step II

The teacher will further explain that "at constant pressure and temperature, the volume of a gas is directly proportional to the number of moles of the gas present".

This implies that as n (amount in moles) increases, V (volume in litre/cm^3) increases, and vice versa.

$V = K_A n$

$\frac{V}{n} = K_A$ or V = constant x n

The constant is the same for all gases at a given temperature and pressure that is Avogadro's law.

Step III

Using different gases the relationship between volume and amount will be explain as follows;

Name	**Pressure**	**Temperature**	**Volume**	**Number of Particle**	**Mass**
Helium (He)	1 atm	0°C (273K)	22.4dm^3	6.02×10^{23}	4.003g
Nitrogen (N_2)	1 atm	0°C (273K)	22.4dm^3	6.02×10^{23}	28.02g
Oxygen (O_2)	1 atm	0°C (273K)	22.4dm^3	6.02×10^{23}	32.00g

It can be seen that, 1 mole of gas occupies 22.4dm^3.

It is at standard temperature and pressure (STP).

Mass of the gas sample depends on the molar mass of the substance.

Step IV

It will be stated, one mole of any gas at STP conditions, occupies 22.4dm^3 of volume. Given 4g of Helium it implies 1mole of helium. Since it is one mole of helium, that contains 6.02×10^{23} molecules of helium gas, which will make up 22.4dm^3 of volume. This large volume will be fully occupied if the temperature is 0°C at pressure of 1 atmosphere. Any change in temperature/pressure will change the volume occupied by the gas.

Evaluation

The teacher will evaluate the lesson as follows:

Given that 1moles of hydrogen fluoride is equal to 6.02×10^{23}

Calculate amount in 4.2moles of the gas.

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give them note to copy on the chalkboard.

LESSON PLAN 6

The Control Group (Lecture Method)

Schools: GSS, Zarewa / GGSC, Karaye

Date:

Time:

Duration: 45minutes

Subject: Chemistry

Topic: Mole Ratio and Mass Relationship in a Reaction.

Class: S.S. II

Number of Students:

Instructional Material. Ababio text book

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

i. Write and balanace some equation involding different chemical reaction

ii. Define and write coefficient as use in mole concept.

Entry Behaviour

Students have some know ledge on balancing equation in their SSI.

Introduction

The lesson will be introduced by writing a simple unbalanced equation. Such as

$NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$ unbalanced

Step I

The unbalanced equation will be balanced, to be able to explain that a balance equation is that which contain equal numbers of atoms on reactant and product sides. E.g.

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$.balanced

From the above equation, two moles sodium hydroxide reacted with one mole of tetraoxosulphate VI acid, it implies that the mole ratio is 2:1 for NaOH to H_2SO_4 respectively.

Step II

Explanation will be given to the students that 2:1 is regarded, as coefficient, which determine the number of moles of substance taking part in that given reaction. Coefficient refer to the number preceding an atom, molecule and molecular formula in a given equation of a reaction examples include the following;

$2H_2 \quad + \quad O_2 \longrightarrow 2H_2O$

$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$

Step III

Using number of moles of reacting substances in calculations, that is mole concept. Explanation will be offered on solving such problem as follows. We can calaculate the volume of gases from a balanced chemical equation, provided that the gases are under the same conditions of temeperature and pressure. The coefficients of gaseous reactants and products in a balanced equation give the mole relations as well as volume relations among the gases for example:

$4NH_3(s) + 5SO_2(g)$		$\longrightarrow$	$4NO(g) + 6H_2O(g)$	
4 vol	: 5 vol	:	4 vol	: 6 vol
4 mol	: 5 mol	:	4 mol	: 6 mol

4 volume of ammonia reaction with 5 volume of oxygen to yield 4 volume of nitrogen (ii) oxide and 6 volume of water vapour. Hence one mole of any gas at STP molar volumes occupies $22.4dm^3$. Thus we can calaculate the volumes, masses, moles and number of molecules of gaseous reactants and products from a balanced chemical reactions.

Examples:

In the industrial preparation of hydrogen trioxonitrate (v) acid, ammonia has NH_3, is burn in oxygen in the presence of catalyst according to the following equations.

$$4NH_3(g) + 5O_2(s) \longrightarrow 4NO(g) + 6H_2O(g)$$

If $260cm^3$ of NH_3 are burn completely; what a volume of (a) O_2 is used up? (b) NO is produced.

Answer

Equation for the reaction.

$4NH_3(g)$	+	$5O_2(g)$	$\longrightarrow$	$4NO(g)$	+	$6H_2O(g)$
4 vol	:	5 vol	:	4 vol	:	6 vol
1 mol	:	5/4 mol	:	4/4 mol	:	6/4 mol

$260cm^3$ of NH_3 will use up $5/4 \times 260cm^3 = 325cm^3$ O_2

$260cm^3$ of NH_3 will use up $4/4 \times 260cm^3 = 325cm^3$ NO

Evaluation

The teacher will evaluate the lesson by asking the following question:

Write and complete the equation for the following reactions by indicating the reactants and products mole ratio:

$Na_2CO_3 + H_2S0_4 \longrightarrow$?

$HNO_3 + CuSO_4 \longrightarrow$?

CONCLUSION: The teacher conclude the lesson by summarizing the important key points of the lesson and also give them note to copy on the chalkboard.

APPENDIX F

ITEM ANALYSIS OF CHEMISTRY STUDENT PERFORMANCE TEST

(CSPT)

S/NO	$\text{F.I.} = \frac{R_U + R_L}{N}$	$\text{D.I.} = \frac{R_U - R_L}{\frac{1}{2}N}$
1.	0.71	0.30
2.	0.32	0.36
3.	0.29	0.30
4.	0.54	0.36
5.	0.75	0.30
6.	0.46	0.36
7.	0.39	0.36
8.	0.43	0.14
9.	0.30	0.50
10.	0.50	0.36
11.	0.30	0.14
12.	0.30	0.50
13.	0.50	0.14
14.	0.38	0.14
15.	0.30	0.43
16.	0.11	0.07*
17.	0.54	0.64
18.	0.44	0.14
19.	0.71	0.30
20.	0.32	0.36
21.	0.61	0.30
22.	0.21	0.30
23.	0.43	0.43
24.	0.64	0.43
25.	0.14	0.14
26.	0.14	0.00*
27.	0.57	0.30
28.	0.68	0.36
29.	0.25	0.30
30.	0.30	0.07*
31.	0.14	0.00*
32.	0.75	0.30
33.	0.50	0.14
34.	0.64	0.43
35.	0.32	0.36
36.	0.61	0.07*
37.	0.14	0.00*
38.	0.18	0.07*
39.	0.11	0.07*
40.	0.68	0.36

*Question were reconstructed

APPENDIX G

TABLE SPECIFICATION OF ITEM

Unit	Topics	Number of Items Chosen	sum
1.	Mole	2,3,6,10,11,17,18,2736,	9
2.	Mole and Avogadro's Number	1,7,23,34	4
3.	Molar mass & Avogadro's Number	8,14,19,20,24,25,31,35	8
4.	Mole-mass No Conversion	13,15,20,30,33,37,38	7
5.	Volume-amount in gases	5,16,28,29,32,39,40	7
6.	Mole concept	4,9,12,21,22	5
	Total	**40**	**40**

APPENDIX H

Table 3.2b Summary of ANCOVA between Pre-test Scores in Chemistry Students Performance Test(CSPT) between the Four Schools Selected.

					95% Confidence Interval for Difference[a]	
(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.[a]	Lower Bound	Upper Bound
sch1	sch2	-3.076*	1.542	.048	-6.121	-.030
	sch3	-.109	1.333	.935	-2.742	2.524
	sch4	-2.074	1.545	.181	-5.127	.978
sch2	sch1	3.076*	1.542	.048	.030	6.121
	sch3	2.966*	1.003	.004	.985	4.948
	sch4	1.001	.683	.145	-.348	2.351
sch3	sch1	.109	1.333	.935	-2.524	2.742
	sch2	-2.966*	1.003	.004	-4.948	-.985
	sch4	-1.965	1.002	.052	-3.945	.015
sch4	sch1	2.074	1.545	.181	-.978	5.127
	sch2	-1.001	.683	.145	-2.351	.348
	sch3	1.965	1.002	.052	-.015	3.945

*. The mean difference is significant at the .05 level.

Table 3.2b shows the pretest mean differences between the four schools selected for the study. The mean difference between school 1 and school 2 was -3.076 in favor of school 2, which was significant (p=0.048). Between school 2 and school 3 the mean difference was 2.966 in favor of school 2, which was significant (p=0.004). When the mean for school 4 was compared with the means of the other 3 schools, the means differences were not significant (all the p-values were>0.05).

APPENDIX I
Summary of Independent Sample T-test for Experimental and Control Groups

```
T-TEST GROUPS=group(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=posttest
  /CRITERIA=CI(.95).
```

T-Test

[DataSet0]

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest	1 experimental	89	33.90	3.681	.390
	2 control	72	25.13	2.355	.278

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
posttest	Equal variances assumed	46.477	.000	17.526	159	.000	8.774	.501	7.785	9.763
	Equal variances not assumed			18.324	151.520	.000	8.774	.479	7.828	9.720

APPENDIX J
Summary of Independent Sample T-test for Experiments Group

```
T-TEST GROUPS=sex(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=posttest
  /CRITERIA=CI(.95).
```

[DataSet0]

T-Test

group = experimental

Group Statistics[a]

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Posttest	1 male	45	37.07	1.970	.294
	2 female	44	30.66	1.584	.239

a. group = 1 experimental

Independent Samples Test[a]

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
posttest	Equal variances assumed	.222	.639	16.886	87	.000	6.408	.379	5.653	7.162
	Equal variances not assumed			16.928	83.889	.000	6.408	.379	5.655	7.160

a. group = 1 experimental

APPENDIX K
Summary of Mann-Whitney Test for Exerpimental and Control Groups

```
NPAR TESTS
  /M-W= tmscore BY group(1 2)
  /STATISTICS=DESCRIPTIVES
  /MISSING ANALYSIS.
```

NPar Tests

[DataSet0]

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
total motivation scores	161	76.64	9.579	55	97
Group	161	1.45	.499	1	2

Mann-Whitney Test

Ranks

	group	N	Mean Rank	Sum of Ranks
total motivation scores	1 experimental	89	116.04	10327.50
	2 control	72	37.69	2713.50
	Total	161		

Test Statistics[a]

	total motivation scores
Mann-Whitney U	85.500
Wilcoxon W	2713.500
Z	-10.619
Asymp. Sig. (2-tailed)	.000

APPENDIX L
Summary of Mann-Whitney Test for the Experimental Group

```
NPAR TESTS
  /M-W= tmscore BY sex(1 2)
  /STATISTICS=DESCRIPTIVES
  /MISSING ANALYSIS.
```

NPar Tests

[DataSet0]

group = experimental

Descriptive Statistics[a]

	N	Mean	Std. Deviation	Minimum	Maximum
total motivation scores	89	84.34	3.705	74	97
Sex	89	1.49	.503	1	2

a. group = 1 experimental

Mann-Whitney Test

Ranks[a]

	Sex	N	Mean Rank	Sum of Ranks
total motivation scores	1 male	45	51.87	2334.00
	2 female	44	37.98	1671.00
	Total	89		

a. group = 1 experimental

Test Statistics[a,b]

	total motivation scores
Mann-Whitney U	681.000
Wilcoxon W	1671.000
Z	-2.552
Asymp. Sig. (2-tailed)	.011

a. group = 1 experimental

b. Grouping Variable: sex

APPENDIX M

Examples of Mastery Learning Enrichment Questions

The following questions are divided into two ways; the essays and objectives, these are design for those students that have scored above the formative test in their level of achievement in mastery learning

SECTION A

Define the term:

1) The mole
2) Molar mass
3) Distinguish between a standard and molar solution
4) Balance the reaction between sulphuric acid and potassium hydroxide
5) 10.0ml sample of concterated HNO_3 (15.8ml) is diluted to a final volume of 500.0ml. What is the morality of the final solution?
6) In the reaction $2H_{2(q)} + O_{2(aq)} \rightarrow 2H_2O_{(q)}$, 0.5m of hydrogen contain 80cm3 of the gas which react with 25cm^3 of the oxygen, calaculate the concentration of the resiual gases.

SECTION B

1. What is the volume occupied at s.t.p by 0.1 mole of hydrogen sulphide.
   a) 22.4dm^3
   b) 2.24dm^3
   c) 0.224dm^3
   d) 43.2dm^3
2. What is the molar concentration of a solution containing 1.12g of KOH in 250 cm^3 of the solution? Given that KOH=56.
   a) 0.08mol/dm^3
   b) 0.05 mol/dm^3
   c) 0.08g/m^3
   d) 0.08cm^3
3. The mole concentration of a solution is the amount in mole of a solute in
   a) 1000cm^3 of aqueous solution
   b) 1dm^3 of the aqueous solution
   c) 100cm^3 of water
   d) 1dm^3 of water
4. What volume of distilled water should be added to 400cm^3 of 2.0 mole/ dm^3 H_2SO_4 to obtain 0.20mol/dm^{-3} solution.
   a) 400cm^3
   b) 3.600cm^3
   c) 3.600g
   d) 400g

5. A mole of any element contains as many atoms as there are in exactly;
    a) 2 grams of hydrogen
    b) 12 grams of carbon $^{-}$12
    c) 8 grams of oxygen
    d) 16 grams of sulphur.
6. How many moles are there in 20g of $CaCO_3$, Given that (Ca = 40 C = 12 O = 16)
    a) 2moles
    b) 0.2moles
    c) 2.2moles
    d) 0.022moles
7. Consider the reaction/equation. $2KOH_{(aqs)} + H_2SO4_{(aqs)} \rightarrow K_2SO_{4(aqs)} + 2H_2O_{(L)}$. $25cm^3$ of 0.05m solution of the acid was neutralized $25cm^3$ of the base what is the morality of KOH solution.
    a) 0.05m
    b) 0.35m
    c) 0.1m
    d) 2.0m
8. In Neutralization reaction of NaOH and H_2SO_4 the mole ratio of the base is
    a) 1:2
    b) 2:1
    c) 1:1
    d) 2:3
9. A mixture containing $300cm^3$of anhydrous sodium trioxocarbonate (iv) present in 0.1m; calculate the number of Na_2CO_3 particles present in the solution (Na = 23, C = 12, O = 16).
    a) 1.81×10^{23} particles Na_2CO_3
    b) 1.81×10^{22} Particles Na_2CO_3
    c) 1.81×10^{22} particles Na_2CO_3
    d) 1.81×10^{23} particles Na_2CO_3
10. How many moles are there in 30g of calcium chloride [$CaCl_2$ – 111g].
    a) 0.27 mole
    b) $0.27g/dm^{-3}$
    c) 0.25m
    d) 0.55moles.

Strategies applied in this lesson were: Mastery Learning Instructional Strategy and Lecture Method