EFFECT OF PERSONALIZED-LEARNING STRATEGY ON SELF-EFFICACY AND PERFORMANCE IN MOLE CONCEPT AMONG SECONDARY SCHOOL STUDENTS, ZARIA EDUCATION ZONE, KADUNA STATE, NIGERIA

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SEPTEMBER, 2021

DECLARATION

I declare that the contents in this Thesis titled "**Effect of Personalized-Learning Strategy on Self-Efficacy and Performance in Mole Conceptamong Secondary School Students, Zaria Education Zone, Kaduna State Nigeria**"was carried out by me in the Department of Science Education under the supervision of Prof. J.S. Mari and Dr.U.A. Ginga. The information derived from literatures have been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or in any other Institution.

PatienceGUYAH
Name of Student Date

CERTIFICATION

This thesistitled "**Effect of Personalized-Learning Strategy on Self-Efficacy and Performance in Mole Conceptamong Secondary School Students, Zaria Education Zone, Kaduna State Nigeria**" by Patience, GUYAH meets the regulations governing the award of the degree of Master of Education Chemistry of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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Chairman, Supervisory Committee

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Dean, School of Postgraduate Studies Date

DEDICATION

This work is speciallydedicated to my parent; Mr. and Mrs. James Yisboh Guyah and my wonderful siblings; Isaac, Prudence, Emmanuel and Victory Guyah. I am indebted to you all, God bless you.

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TABLE OF CONTENT

CONTENTS **PAGE**

CHAPTER TWO: REVIEW OF RELATED LITERATURES

CHAPTER THREE: METHODOLOGY

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

OPERATIONAL DEFINITION OF KEY TERMS

Personalized-Learning Strategy:	This is a method that allows learners to plan and execute their learning activities with the aim of achieving a set goal at a particular time.
Self-Efficacy:	This refers to one’s belief or feeling that he/she can perform a given task at any time.
Academic Performance:	Academic performance refers to the outcome of a student’s learning process which can be achieved through formative evaluation.
Mole:	Mole is the amount of a substance contained in any given sample.

LIST OF ABBREVIATIONS

ACI	Analytical Chemistry I
CAT	Chemistry Achievement Test
CSS	Chemistry Self-Efficacy Scale
DMCTE	Debre Markos College of Teacher Education
FRN	Federal Republic of Nigeria
GPA	Grade Point Average
MCPT	Mole Concept Performance Test
NUT	Nigerian Union of Teachers
PLS	Personalized-Learning Strategy
PPMC	Pearson Product-Moment Correlation Coefficient
SAIP	Self-Assessment Instructional Programme
SAS	Self-Assessment Scale
SEQ	Self-Efficacy Questionnaire
ZPD	Zone of Proximal Development

ABSTRACT

This study investigated the Effect of Personalized-Learning Strategy (PLS) on Secondary School Students' Self-Efficacy and Performance in Mole Concept. The design was quasi-experimental involving 143 students as sample for the study. The experimental group was treated using PLS while the control group was taught using the conventional method. Two validated instruments; Mole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ) were used for data collection. The reliability coefficients (*r*) of MCPT and SEQ were 0.81 and 0.89 respectively. Descriptive statistics was used to answer the research questions while the null hypotheses were tested using Mann-Whitney U-test and independent samples t-test at $P \leq 0.05$ levels of significance for students' self-efficacy levels and academic performance respectively. Results revealed statistical significant differences between the self-efficacy level of students in the treatment and control groups; (U=564, P= 0.001) while it was not significantly different between the male and female students; (U=309, P= 0.58). Their performance in the treatment and control groups was also statistically and significantly different (t (141) =2.65, P= 0.009) but no statistical difference of significance was observed between the male and female students (t (52) =1.65, P= 0.12). Findings of this study suggest the effectiveness of PLS as a teaching strategy and thus recommends among others, its adoption by chemistry teachers because of its positive effect on students' self-efficacy and gender suitability.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

The overall development of any nation is largely dependent on the level of educational attainment by her citizens especially in the area of science and technology. Science is a body of knowledge that involves the systematic approach of gathering, organizing and use of information about the physical and natural world to solve problems. Scienceaccording to Harper (2014), is a systematic enterprise that builds and organizes knowledge in the form oftestable explanations and predictions about the universe. Aniodoh (2012) defined science as a way of investigation and a body of established knowledge. The importance attached to science today in the World and by the Federal Government of Nigeria is due to the general belief that science is capable of improving and changing skills, attitudes and cognition by increasing pupilsstore of knowledge about themselves, their environment and their world as stipulated in National Policy on Education (FRN, 2013). It is the solid rock for the growth and technological advancement of any nation (Obomanu & Onuoha, 2012) and hence, a social and economic forces for the growth and development of any Nation. Chemistry as a subject and field of study is the heart of science and technological development. Chemistry education has been identified to be one of the major bedrocks for the transformation of national economy and according to Lawrence and Abraham (2011),this must be given adequate attention due to the gains of learning and advancement of science education.

Chemistry according to Avaa (2002) has been identified as a very important science subject and its importance in scientific and technological development of any nation has been widely reported. In addition, Adesoji and Olatunbosun (2008) stated that the recognition given to

Chemistry in the development of individual and the nation has made it a core-subject among the natural sciences and other science-related courses in the Nigerian educational system.Chemistry according to Ababio (2007) is an aspect of science that studies the composition, properties and uses of matter. Similarly, Okeke and Ezekannagba (2000) also defined chemistry as a branch of physical science that deals with the composition and the changes that matter undergoes. The role and importance of chemistry in the development of the scientific base of a country according to Donald (2010) cannot be over-stressed and Nigeria like many other developing nations is not an exception. Additionally, chemistry according to Oloyede (2010) is one of the Science subjects taught at the senior secondary school level and one of the core sciences subjects that students are required to pass in order to qualify for admission into tertiary institutions to pursue science-based programmes for example; Medicines, Engineering, Pharmacy among others.According to Ababio (2007) and Opara and Waswa (2013), chemistry is everywhere; it is life; because it investigates the world around us and has contributed greatly towards providing us with basic needs of life such as food, clothing, housing, drugs, transportation, fertilizers, insecticides among others.

Despite the key role of Chemistry as the central science that forms the basic foundation to many disciplines and in improving the quality of life;according to Jegede (2010) and Oloyede (2010) the performance of Nigeria secondary school chemistry students in the subject has for many years remained a matter of concern. In addition, a study revealed that there is consistent decline in the performance of chemistry students in public examinations conducted by the West African Examination Council (WAEC) (Samba & Eriba, 2012). WAEC also confirmed this decline in performance in Chemistry by WAEC Chief Examiner’s Reports (2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019 & 2020) as shown in Table 1.1. This poor performance of students in Chemistry is due to some multifaceted factors. According to Abdullahi (2015), the factors that negatively affect Chemistry performance include students' lack of interest, abstractness of the concept, lack of self-efficacy, poor study habit and teacher-related factors, like teachers' poor preparation, unqualified Chemistry teachers and application of poor teaching methods.A number of studies exist in the science education literature that deal with the main learning difficulties about the Mole Concept (Ephraim, 2016).

Mole is a concept devised by scientists to aid in chemical calculations; and Furió, Azcona, Guisasola and Ratcliffe(2000)opined that students' misconceptions could be due to insufficient instruction or inappropriate teaching strategies. It is therefore wise for chemistry to be taught meaningfully by using appropriate instructional strategies due to its importance.Mole Concept is a term that describe the amount of substances. Mole is the amount of substances (Akusoba & Ewelukwa, 2011) which contains Avogadro's number of particles whether atoms, molecules, ions, electrons, protons or neutrons. According to Odesina (2015), a mole of any substance is the amount of it which contains as many elementary particles as there are atoms. It is therefore the unit use for measuring the amount of matter in terms of number of particles. For improved performance therefore and better understanding, effective method of instruction needs to be employed in the teaching of Mole Concept like Personalized-Learning Strategy.

The concept of personalized instruction is advanced from the more fundamental ideas of individualized and differentiated learning. Individualized instruction according to Bloom (1971) is paced based on the learning needs of different learners as in mastery learning whiledifferentiated instruction is geared towards the interests and readiness of different learners (Tomlinson, Brimijoin & Narvaez, 2008). Personalized instruction encompassesindividualization and differentiation, adapting for both pace of the students and the approach adopted by the teacher.

According to Patrick, Kathryn and Allison (2013),Personalized-Learning Strategyrefers to a diverse variety of educational programmes, learning experiences, instructional approaches, and academic support strategies that are, designed to enable the academic success of each student by first determining the learning needs, interests, and aspirations of individual students, and then providing learning experiences that are customized to a greater or lesser extent for each student. The quality of learning is tied to a shift from the traditional teaching process to micro education, personalization, and the adjustment of the level according to the proficiency level of the students in the teaching process. Personalized-Learning Strategy enables students to take their personal learning needs into considerations, which when used with the traditional instruction methods, tends to reduce students' learning time (Hotomaroglu, 2012) and could improve academic performance.

Personalization of learning is student-centered according to Pittock (2017) and it provides students more opportunity for organization around their learning and enables practices such as planning and designing conferences between the student and teacher, ongoing formative assessment (assessment for learning) that authentically involves students, and student learning portfolios that gather evidence of learning. It also considers summative assessment (assessment of learning) that involves students receiving a grade which indicates their level of performance (Glickman, Gordon & Ross-Gordon, 2009). Personalization of learning provides support and feedback which according to the opinion of Walonoski and Hefferman (2006), help individual learners improve their learning performance based on personal information, profiles, or learning portfolios (purposeful collection of student work that shows their effort, progress and achievements) which plays a major role in learning.This is because through personalization of learning and students' feedback,curricula objectives are designed to improve students' understanding which reflects on their overall academic performance.

The fundamental features of Personalized-Learning according to Cullhaj (2017) and Pane, Steiner, Baird, Hamilton and Pane (2017)is hinged on learner profiles where emphasis is placed on understanding each and every student which provide portals for educators to get to know every single student on a personal level with resources tailored to each one; Personalized-Learning paths where each student follows a customized path that responds and adapts based on his or her learning progress, motivations, and goals allowing for independent learning; competency-based progression that involves a process whereby each student's progress toward clearly defined goals is continually assessed; and flexible learning environment where the need of the student drive the design of the learning environment. These types of systems were considered to be adaptive in nature, adjusting as necessary to learners' needs in an effort to move towards a more student-centered approach to learning (Hwang, Sung, Hung, Huang & Tsai, 2012). Personalized-Learning Strategy involves students reading texts, solving problems and forming their notes with the aid of conventional notes prepared by the teacher,while the control group was exposed to the whole class conventional teaching. Personalized-Learning Strategyhas been reported to increase students' academic performance according to Akinsola and Awofala (2009). Self-efficacy of students may also be improved through the use of Personalized-Learning Strategy. In this study therefore, the researcher investigates whether Personalized-Learning Strategy can improve or promote self-efficacy and academic performance of chemistry students at secondary schools.

Self-efficacyaccording to Axtell and Parker (2013), is an individual's belief in his or her innate ability to achieve goals. Self-efficacy refers to people's judgements about their capability to perform particular tasks; and it increases the effort and persistence towards challenging tasks; therefore, increasing the likelihood that they will be completed. Self-efficacy is the belief a person holds about whether or not he/she can successfully attain a desired level of performance which according to Golnaz (2011) varies on three dimensions: level (the number of tasks a person can do); strength (how resolutely a person believes in his ability to perform each task); and generality (the extent to which expectancies can be generalized from one situation to the next). Self-efficacy affects behaviors and social interactions in multiple ways and is a central tenet of positive psychology, which focuses on the factors that create meaning for people (Golnaz, 2011). Self-efficacy is one's belief in the likelihood of goal completion, and can be motivating in itself (Van-der-Bijl & Shortridge-Baggett, 2012). Wigfield and Wagner (2012) stated that learners with a strong sense of self-efficacy approach complex and challenging learning tasks with a sense of confidence that if they use good strategies, practice smart, persistence and utilize the full range of resources available to them, they can and will succeed.

Bandura (1986)opined that the type of learning environment and teaching method can improve self-efficacy in the classroom. In a similar result reported by Fencl and Scheel (2005) in a study of non-majors' physics course where the effects of different teaching methods on the classroom climate and self-efficacy were measured. The students' response indicated that a question-and-answer format, inquiry-based lab activities and conceptual (rather than quantitative) problems had a significant effect on creating a positive climate in the classroom. In addition to those pedagogies, collaborative learning and the use of electronic applications showed a positive correlation with increased self-efficacy in their studied sample. Students' self-efficacy can be tested with their feedback. Bandura (1997) stated that factors that improves students' academic performance will increase their self-efficacy level. Hence, teachers' direct contact and

Personalized-Learning Strategy will affect their self-efficacy level and academic performance while Personalized-Learning has been studied, its influence as source of self-efficacy has not been assessed. Therefore,Personalized-Learning Strategywas used in this study to see whether it will improve students' self-efficacy and academic performance in chemistry.

Academic performance has to do with the successful accomplishment of goal(s). Academic achievement (performance) is the outcome of education, that is, the extent to which a student, teacher or institution has achieved their educational goals (Barnard, 2004). Also, some authors define academic achievement as the level of schooling you have successfully completed and the ability to attain success in your studies (Epstein, 2011). The academic achievement of a school child in any school subject can be attributed to many factors. Factors responsible for academic achievement are associated with socio-economic, gender, school environment, teaching strategies and equipment (Nwachukwu, 2014). Students who achieve well academically have some advantages. Academic achievement serves as a key criterion in order to judge students' true potentials and capabilities (Nuthanap, 2007& Daulta, 2008). Performance differs with individuals and hence may also differ among gender. Therefore, in this study, an investigation will be made on Personalized-Learning Strategy to see whether it will improve the academic performance of both male and female.

Gender is the range of characteristics pertaining to, and differentiating between masculinity and femininity. Depending on the context, these characteristics may include biological sex (that is, the state of being male, female, or an intersex variation such as transgender, bisexual and hermaphrodite), sex-based social structures (that is, gender roles), or gender identity (Haig, 2014).There are still varied view points as well as different conclusions on gender and academic performance. Indication on gender differences on students' academic performances differ among gender in the science subjects. Okoye (2013) considered gender as a range of physical, mental and behavioural characteristics pertaining to and differentiating the masculinity and feminity of an individual. In the process of learning science-based subjects, some researches show superiority of male over female students and others show superiority of females over males. Raimi (2010) also opined that gender is not a significant factor to be associated with students' performance. If given equal opportunity with the right teaching and learning process, male and female students will achieve equally**.**The observations agree with Udoh (2015) which showed no significant difference in gender on students’ academic performance and retention in Biology when taught nervous coordination using computer simulation and charts. Udoh (2015) argued that in a classroom setting where male and female students are actively involved in an interactive lesson with the teacher, there will be no difference in their academic performance. Ekeh (2014) observed that male students performed significantly better than their female counterparts in mathematics when taught using iconic models. Personalized-Learning Strategyhas been shown to have no significant effect on male and female students (Chen & Liu, 2007; Nurretin & Ozlem, 2009). Etiubon (2011) observed that female students performed significantly better when exposed to the use of different technological tools in electrolysis than their male counterparts in chemistry. Olasheinde and Olatoye (2014) also found that there was no significant effect on gender with regards to students' achievement in science. Gender’s effect on academic performance has not been established, hence, this study seeks to investigate the effect of Personalized-Learning Strategy on self-efficacy and academic performance in Mole Concept to see whether it is gender friendly.

1.1.1 Theoretical Framework

This study is based on the theories of Piaget (1964), Vygotsky (1978) and Bandura (1977). Piaget's theory of cognitive development (1964) states that, developmental stages deal with the nature of knowledge itself and how humans gradually come to acquire, construct, and use it. Intellectual development according to Piaget (1964) is a direct continuation of inborn biological development. Piaget explains cognitive developmental stage as the change in reasoning level of a child acquiring new ways of understanding their environment. The implication of Piaget's theory assumes that all children go through the same sequence of development, but they do so at different rates. Teachers must make a special effort to provide classroom activities for individuals and small groups, rather than for the total class group. Assessment should be based on individual progress, rather than on the normal standards of same age peers. Individuals construct their own knowledge during the course of the interaction with the environment. Individual needs when identified and addressed through adequate learning style, classroom environment, learning at their pace, among others is capable of enhancing academic performance. Piaget who is considered as the founder of individual constructivism, believes that learning is strongly influenced by learners' developmental stages. Hence, since the learners will be allowed to learn and understand at their own pace, this may lead to effective knowledge acquisition and improved academic performance. This theory would appear to support the use of Personalized-Learning Strategy and would help students to identify and address individual needs, adequate learning style, content, method and pace. It also enables students to acquire skills that would go beyond academia and will help them in the nearest future. Personalized-Learning Strategy also improves students' knowledge, self-efficacy and academic performance.

Vygotsky theory of social interaction (1978), states that a child's cognitive development is as a result of social interaction. Vygotsky further stated that, “Every function’’ in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter-psychological) and then inside the child (intra-psychological). Vygotsky believes that young children are curious and actively involved in their own learning and the discovery and development of new understandings. Social interaction plays a fundamental role in the development of cognition. Social interaction emphasized that effective learning happens through participation in social activities, making the social context of learning crucial. The four (4) Basic principles of Vygotsky theory are; Children construct their knowledge, Development cannot be separated from its social context, Learning is mediated, and Language plays a central role in mental development. Vygotsky emphasizes on the role of active involvement in learning in relation to the child's environment. The teacher acts as a facilitator who encourages students to discover principles for themselves and to construct knowledge by working to solve realistic problems. This implies that the students must take some responsibility for their learning. This is because they have to be actively involved in teaching and learning process. This theory would appear to support the use of Personalized-Learning Strategy. Personalized-Learning Strategy (PLS) increased basic skills, students' performance, positive interactions and students' self-efficacy. It also encourages students to construct knowledge by working to solve realistic problems and creates enabling environment for students to learn from themselves, which would increase students' self-efficacy and academic performance.

Bandura social learning theory (1977), states that people learn from one another, via observation, imitation and modelling. People learn through observing others behaviour, attitudes and outcomes of those behaviours. Bandura explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioural and environmental influences. Bandura believes that human functioning is not enough for a person to possess the requisite knowledge and skills to perform a task; one also must have the conviction to successfully perform the required task under difficult circumstances. Bandura emphasized that the most useful efficacy judgments are those that slightly exceed one's actual capabilities, as this overestimate can actually increase effort and persistence during difficult times. Therefore, increasing self-efficacy and self-confidence in order to improve academic performance will be more effective when individuals are considered and conscious efforts are made to enhance their self-efficacy and academic performance through personalization of instruction.

Therefore, this study adopts the theories of cognitive developmental stage of Piaget, social interaction theory of Vygotsky and social learning theory of Bandura. It is in the scope of this work therefore to investigate the effect of Personalized-Learning Strategy on self-efficacy and academic performance of secondary school chemistry students in Mole Concept.

1.2 Statement of the Problem

Poor performance in chemistry has been reported according to Jegede (2010) and Samba and Eriba (2012)which could be attributed to many factors as stated by Barineka (2012) andHassan, Ali, Salum, Kassim, Elmoge and Amour (2015) ranging from the attitude of the student towards the subject, abstractness of its concepts, lack of self-efficacy, instructional methods and teaching aids.These objectives are yet to be realized due to students' persistent poor academic performance despite several efforts through researches (Ameh & Dantani, 2012; Daluba, 2013). Poor performance of chemistry students in Mole Concept has been reported which according to Omwirhiren (2015) can be attributed to their weakness in writing and balancing of chemical equations.

Several researchers focused mainly on different instructional methods such as inquiry method, demonstration method, field trip, problem solving, among others to improve students' academic performance but poor performance in chemistry still exist as stated in WAECChief Examiner's report (2012-2020) as presented in Table 1.1. This calls for the use of more friendly methods of instruction such as Personalized-Learning Strategy which is limited and may be another source of poor performance in chemistry at secondary school level.This is because other methods are concerned with teaching students as a whole class without taking cognizance of individual learning needs such as learning at their pace, content, method among others.

Table 1.1: Performance of Students in Chemistry at SSCE (WAEC) in Zaria Education Zone Kaduna State: 2012-2020

Year	Number of Students With A1-C6	(%) of Students With A1-C6	Number of Students With D7-F9	(%) of Students With D7-F9	Total number of Students
2012	489,960	33.90	955,351	66.10	1,445,311
2013	698,952	43.38	912,280	56.62	1,611,232
2014	767,247	48.62	810,802	50.38	1,578,049
2015	736,171	46.09	861,076	53.91	1,597,247
2016	713,982	45.70	848,341	54.30	1,562,323
2017	499,258	40.20	742,852	59.80	1,242,110
2018	357,447	36.20	630,050	63.80	987,497
2019	375,475	34.80	640,505	65.20	1,015,979
2020	303,084	38.11	594,890	61.89	897,973

Source: Ministry of Education, Science and Technology, Zaria, Kaduna State (2020)

The use of Personalized-Learning Strategy may take care of individual differences since the students are allowed to learn at their pace.Student-centered method of instruction like metacognitive self-assessment strategy has improved students' self-efficacy and performance in chemistry as stated by Jacobson (2010), but the use of Personalized-Learning Strategy has not been usedespecially on difficult concepts like the mole whichmay also enhance students' self-efficacy and performance.The development of science in Nigeria has been reported to be hindered by low self-efficacy of students (Yusuf, 2011)which was also reported to affect academic performance (Mari & Gumel, 2015).This may be due to the use of teacher-centred instructional method. Instructional strategy like Personalized-Learning Strategy which allows students to learn at their pace is known to enhance self-efficacy (Akinsola & Awofala, 2009). Hence, the study investigated whether Personalized-Learning Strategy will enhance chemistry students' self-efficacy and academic performance in Mole Concept at secondary schools in Zaria, Kaduna State, Nigeria.

1.3 Objectives of the Study

The objectives of the study were to:

i. investigatethe effect of Personalized-Learning Strategyon Self-Efficacy ofSecondary School Chemistry Students in Mole Concept.
ii. find out the effect of Personalized-Learning Strategyon Academic Performance of Secondary School Chemistry Students in Mole Concept.
iii. find out the effect of Personalized-Learning Strategyon Self-Efficacy of male and female Secondary School Chemistry Students in Mole Concept.
iv. determine the effect of Personalized-Learning Strategyon the Performance of male and femaleSecondary School Chemistry Students in Mole Concept.

1.4 Research Questions

The following research questions were formulated to guide the study:

i. What is the mean difference between self-efficacy of chemistry students taught Mole Conceptusing Personalized-Learning Strategy and those taught with conventional method?
ii. What is the difference between the mean academic performance scores of chemistry students taught Mole Conceptusing Personalized-Learning Strategy and those taught with conventional method?
iii. What is the mean difference in self-efficacy between male and female students taught Mole Concept using Personalized-Learning Strategy?
iv. What is the difference in the mean academic performance scores between male and female students taught Mole Concept using Personalized-Learning Strategy?

1.5 Null Hypotheses

The following null hypotheses are formulated to be tested at $P \leq 0.05$ levels of significance:

i. There is no significant difference between self-efficacy of chemistry students taught Mole Concept using Personalized-Learning Strategyandthose taught using the conventional method.
ii. There is no significant difference between the mean academic performance scores of chemistry students taught Mole Concept using Personalized-Learning Strategy and those taught the concept using conventional method.
iii. There is no significant difference in self-efficacy between male and female students taught Mole Concept using Personalized-Learning Strategy.
iv. There is no significant difference in the mean academic performance scores between male and female students taught Mole Concept using Personalized-Learning Strategy.

1.6 Significance of the Study

The outcome of this study will hopefully be of immense benefit to chemistry education in the following ways:

Chemistry Students: To the students, the findings will assist them in discovering true meaning and understanding of chemistry concepts, clear their misconceptions they might have had about mole as a concept. It will help the students to form basic knowledge and develop their self-efficacy and overall performance in chemistry.

Chemistry Teachers: The outcome of this study will expose chemistry teachers to more effective techniques of teaching Mole Concept at secondary school level. Also, it will enable chemistry teachers to adjust their teaching pattern and recognize students' individual needs and personal ideas that may necessitate their improved performance in the classroom. This will enable the teachers to enjoy teaching as students achieve highly.

Education Stakeholders at Policy level: The federal ministry of education and other education stakeholders will through this study organize workshops, seminars and conferences for review of pedagogy in science teaching to address the issue of integrating new ideas on teaching and learning of chemistry. It might help them in identifying the concept of learners' cognitive needs and teacher's instructional style in educational programme planning that could be included in later review of chemistry curriculum.

Researchers: Researchers will through the result of this study shift to verifying a more student -centered learning approach that may improve their learning needs and performance. It will also serve as foundation for further studies and enriching existing literatures.

Professional Bodies: This study will provide useful information to professional bodies like Chemical Society of Nigeria (CSN), Science Association of Nigeria (SAN), Science Teachers Association of Nigeria (STAN), which can enrich their methods, courses and develop new programme of instruction based on the findings.

Curriculum Planners: The findings will be of use to the curriculum planners, to plan chemistry curriculum in such a way that the contents will be a guide to learners and teachers. Curriculum planners would find the result of this study a relevant tool for curriculum reforms and improvement. The result of the study will also help in explaining the theories of Piaget on individual developmental stage, Vygotsky on zone of proximal development and Bandura on self-efficacy.

1.7Scope of the Study

This study focuses on Senior Secondary School Chemistry Students in Zaria Education zone, Kaduna State, Nigeria. The study is limited to Sabon-Gari Local Government area because the concept had been taught in other locations with different teaching methods yet poor academic performance still persist (Omwirhiren, 2015).The topic is limited toMole Concept which are:

i. Mole,
ii. Avogadro’s number,
iii. Molar mass and
iv. Chemical equation.

This is because it is taught at this stage in the chemistry curriculum and considered a major challenge to chemistry students due to their poor performance. Hence, the researcher usedPersonalized-Learning Strategy to teach these concepts to see whether it will improve students' self-efficacy and their academic performance.

This study is limited to SS2 chemistry students in the study area. The reason for the selection of SS2 students is that they are stable, as against SS1 who are just coming into the system and SS3 students who are preparing for external examinations. Two co-educational public secondary schools were used for the study.Personalized-Learning Strategyinvolving teaching procedures using reading materials such as conventional notes, text books and charts were used for the experimental group guided by the teacher while the control group were taught using the conventional method for the whole class for six weeks.

1.8 Basic Assumptions

This study has the following basic assumptions:

i. Personalized-Learning Strategy will positively affect student's self-efficacy and performance in learning Mole Concept.
ii. Personalized-Learning Strategywill be Gender friendly.
iii. The sampled schools use the same syllabus.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study attempts to evaluate the effects of Personalized-Learning Strategy on Self-Efficacy and academic performance in Mole Concept among secondary school chemistry students in Zaria, Kaduna State, Nigeria. This chapter reviews the works done by others as theyrelate to this study under the following subheadings:

2.2 Teaching of Chemistry at Secondary School Level
2.3 Academic Performance in Chemistry
2.3.1 Science Teaching Methods
2.3.2 Conventional Method of Instruction
2.4. Personalized-Learning Strategy
2.4.1Models of Personalized-Learning Strategy
2.4.2Personalized-Learning Strategy and Academic Performance
2.4.3 Personalized-Learning Strategy and Self-Efficacy
2.4.4 Personalized-Learning Strategy and Gender
2.5 Concept of Self-Efficacy
2.5.1 Self-Efficacy and Academic Performance in Science
2.6 Gender and Academic Performance in Science
2.7 Gender and Self-Efficacy in Science
2.8 Overview of Similar Studies
2.9 Implication of Literature Reviewed for the Present Study

2.2Teaching of Chemistry at Secondary School Level

Chemistry is one of the most important disciplines in the school curriculum; its importance in the general education has gained world-wide recognition. Chemistry is a branch of science that is rational and quantitative and according to Adesoji and Olatunbosun (2008), it is a discipline where certain measured and controlled inputs lead to certain predictable outputs. It was developed around the 20th century and introduced in the curriculum of both the elementary and secondary education as part of science courses or as separate discipline (Kasalta & Tzougraki, 2004). It is worth to emphasize at this junction that the field of chemistry, science and technology are related to the economic heart of every highly-developed industrialized and technologically advanced society (Burmeister, Rauch & Eilks,2012). The benefit of learning and advancing in science and technology can be intrinsic and extrinsic, 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, ecologic and societal influences (Hofstein, Eilks & Bybee, 2011).

Chemistry is one of the important science subjects taught from the Senior Secondary School (SSS) level through Colleges of Education, Polytechnics up to the University level in Nigeria. Chemistry occupies a central role in science and technology. It is a subject that involves the study of the composition, structure, properties and the changes that matterundergoes(Avaa, 2002; Adesoji & Olatunbosun, 2008). Chemistry as a subject includes according to Ojokuku and Amadi (2010) topics such as properties of atoms and matter, chemical bonds formation, chemical compounds, interactions of substances through intermolecular forces that give matter its general properties, and the interactions between substances through chemical reactions to form different substances. Chemistry is a central science that bridges other natural sciences such as: biology, geology, geography and physics. The centrality of chemistry accounts for it being studied in astronomy, biology, geology, geography and other science-related disciplines (Donald, 2010) and further stated that chemistry overlapped other science subjects for increased national development and economic stability.

A greater deal of work has been done in an effort to identify problem that are inherent in the teaching of chemistry in secondary schools. These factors influence the effective teaching of chemistry which in turn plays a vital role in the lives of the students as it affects their performance. These include; physical classroom and laboratory, instructional arrangement and school management (Johnson, 2011). The other factors include the presence of instructional materials in the laboratory such as apparatus and chemicals (Owoeye & Yara, 2011). The dissemination of information to the students through bulletin boards, posters, and charts, if well organized and accessible to students will enhance assimilation and performance in their academics. Finally, the school management or organization is another vital factor that may be considered before anticipating a good result. The school management’s responsibility now includes positioning of the school laboratory, school library and provision of essential services like water supply, light, food, vendors, counselor services and first aid services (Owoeye & Yara, 2011).

Appropriate teaching and learning of chemistry concepts have positive effects on the rest of science curriculum. General chemistry is a requisite requirement according to Scott and Judit (2009) for students who wish to pursue a carrier in science and health professions. The subject often has low rate of students’ success and as a result, serve as a gate way limiting access to the field of science (Robert, Philip & John, 2005). Students’ poor performance in chemistry according to Ezeliora (2003) was attributed to poor use of instructional strategies involving excessive teacher–talk, copying of notes and rote-learning among others. Ojokuku and Amadi(2010) observed that students perform poorly in the concepts in chemistry, a problem that could be attributed to inappropriate teaching strategies used by the teachers in communicating the concept to the learners.It is of necessity therefore to research into teaching approach that will enhance students' self-efficacy, stimulate interest, increase desire to learn more and improve their academic performance.

2.3Academic Performance in Chemistry

Academic performance of a child is defined as the learning outcomes of the child which according to Pandey (2008) and Kathryn (2010) is defined as the performance of pupils in the subjects they study in the school. Academic performance is highly linked to understanding and retention.Aggarwal (2008) defined retention as the process of relegation of the past experience in the sub-conscious mind of the individual in the form of mental experience. The study of Cheung (2009) reported high correlation between academic performance of chemistry students, their attitudes and manner of learning.

Government participation on educational programmes is also a major factor that affects students' performance in science and school at large (Nzekwe, 2013).Lack of encouragement to teachers by the government also contributes to ineffective teaching and learning of chemistry (Adefunke, 2008). Abdullahi (2009) blamed government for mass failure in chemistry and other science subjectsdue to the following reasons: little resources are made available without implementing effective government policies and servicing of education, inadequate trained staff for monitoring and evaluation of schools; collapsed infrastructure, lack of instructional materials; hostility of the environment, inadequate laboratory trained and experienced personnel, inadequate professional teachers' development and funding of the schools.Hence, the research evaluates the impact of using Personalized-Learning Strategy as viable approach to improve students' self-efficacy and academic performance in Mole Concept as a major topic in chemistry.

2.3.1Science Teaching Methods

Effectiveness of teaching and learning is a factor of functional methodology. Method in education refers to the ways, approaches, procedures, and the kinds of activities that teachers and students engage in the interactive process with a view to inducing, inspiring, and facilitating learning for accomplishing a set of instructional objectives. Method according to Okam (2010) include the utilization of appropriately selected curriculum materials, content and learning experiences, motivational strategies, application of learning theories and the demonstration of a knowledge of developmental psychology or other aspects of educational psychology in the teaching and learning process. Teaching method is a product of the combination of strategies, tactics and techniques (Clark & Starr, 2001). Shymansky and Kyle (2012) were of the view that instructional strategy includes the materials, media, setting and behaviour the teacher uses to create an environment to produce an effect. As a result, the achievement of the instructional goals and the choice of suitable teaching strategies are not separate. Erdem (2012) emphasizes four features of teaching strategies. Firstly, teaching strategies should improve a student's predisposition to learning by increasing the desire for studying and understanding new situation. Secondly, teaching strategies should be structured to help learners rapidly capture the information distributed through the instruction, and develop learner's abilities in assimilating and using knowledge possessed. Thirdly, teaching strategies should be sequenced in the most effective manner so that students can comprehend new knowledge by applying their prior experiences. Finally, teaching strategies should be designed to allow students to genuinely engage in their learning. Effective teaching suggests that both the teacher and learner are fully accommodated in the process. Hence, it suffice to say that a change in behaviour may not easily manifest unless a teacher who of course is regarded as a guide in the teaching process is involved. However,Battro, Fischer and L´ena (2008)noted that knowledge is not something to be poured into the learners' mind like water into an empty bucket, appropriate method of teaching needs to be employed for effective learning to take place. Similarly, Alao (2010) affirmed that effectiveness of a programme could only be achieved if an instruction in that programme is carried out one step after the other starting from simple content to complex one. Improved performance in chemistry concepts is closely linked with teaching strategy employed by the teacher.

Various instructional strategies and techniques have been employed in addition to the traditional conventional method for the teaching of chemistry at the secondary school level for effective learning process. There are as many methods and techniques of teaching science as there are different views of the nature of science (Alao, 2010). These methods include: conventional method (Joshi, 2008), project method (Amosun, 2008), inquiry method (Olajide, 2009; Obeka, 2010), discussion method (Okam, 2010), simulation method (Obeka, 2009), laboratory method (Olajide, 2009; Usman, 2012) and demonstration method (Adekoya &Olatoye, 2011). The study under investigationevaluates the effect of Personalized-Learning Strategy on Self-Efficacy and academic performance of chemistry students in Mole Concept.

2.3.2Conventional Method of Instruction

Conventional method of learning is a talk and listening method of learning where the teacher talks while learners listen actively. It involves the verbal presentation of ideas, concept, and generalization of facts according to Bichi (2002). The method is one of the science teaching strategies that encourages rote learning (memorization) and regurgitation of information without necessarily aiding appreciative understanding. In using this method, the teacher talks while the students listen and learning is seen as something that is poured into the learners like water. According to Joshi (2008), conventional method is also known as talk-and-chalk method in a situation where the teacher decides to write the summary of the point, he/she has taught on the board. In conventional method, the teacher delivers pre-planned lesson to the students sometimes with little or no instructional aids. However, the traditional method of impacting knowledge which the conventional portray require the recipients to listen with rapt attention as the fact are poured out by the teacher who is seen as the Centre piece of knowledge.

Conventional method is used largely due to its advantage of building up basic theoretical knowledge, which must be acquired by the students before being able to display practical skills and undertake practical tasks in the laboratory. It is highly valued in a situation where the number of students who are benefiting from it is quite large and, in a situation, where there is inadequate number of competent and qualified teachers coupled with the insufficient instructional materials, conventional method with note taking technique may be more effective than any other methods. Joshi (2008) established that conventional method serves four basic purposes: motivating students to learn, clarifying students' problems during lessons, reviewing classroom work in order to improve students' mastery of the subjectand to expand ideas, knowledge or information in order to engender interests and mastery amongst students.

Studies such as the work of Joshi (2008) and Atadoga and Lakpini (2013) claimed that in the process of teaching and learning, conventional method is useful in imparting factual information in an efficient manner to convey facts, concepts and principles to students who have difficulty reading their texts. It is easy and convenient for the conventional to deliver his prepared conventional without hustles of practical demonstration and do not considers the possibility of students' participation. The method is convenient and suitable for carrying out a number of academic activities and responsibilities during certain occasions such as introducing a topic, summarizing a subject-matter and in giving instruction before performing any laboratory experiments among others.

Contrary to the advantages of conventional method, it is associated with shortcomings in that it does not make provision for activities as students are reduced to the status of passive listeners which implies limited development of scientific attitude and training.It does not provide immediate mechanisms for ascertaining students' level of understanding and mastery of what is being taught and does not cater for individual needs of students. As noted by Bligh (2012), the conventional format may not be the most effective way to promote thinking and development of attitudes, but changes to conventional techniques may help to overcome such limitations. Selecting appropriate conventional techniques is also one-way to help conventional become more effective. As such, there remains considerable scope to explore the use of technology in enhancing the delivery of, and ultimately, the learning outcomes of a conventional.

In this study, conventional method was used as an instructional strategy for teaching the control group to be compared with teaching the experimental group using Personalized-Learning Strategy and their effect on Self-Efficacy and academic performance of chemistry secondary school students in Mole Concept.

2.4Personalized-Learning Strategy (PLS)

The Personalized-Learning Strategy is based on urging the students individually, to pass through the various learning units, based on their pace, and the precondition of achieving mastery of the previous learning unit, with the provision of encouragement, guidance and assessment from their peers who completed the units and tasks before them (Murphy, Redding, & Twyman, 2016). According to Al-Zboun and Mawadiah (2016), Personalized-Learning Strategy is a system which aims to teach the learner through activities performed personally, based on his/her abilities and needs, in order to acquire knowledge, attitudes, and skills, in addition to self- learning skills with the least amount of the supervision and guidance from the teacher. The concept of Personalized-Learning Strategy has been evolving along with the introduction of emerging technologies and their ubiquitous nature. Schools that offered a personalized approach to learning have been better able to connect with students, find ways to engage them, keep their attention, and help them to capitalize on their strengths as learners (McClure, Yonezawa & Jones, 2010) by including a focus on profiles that enabled each student to be known by instructor, progress based on demonstrated knowledge and skills instead of seat time and have tailored and flexible learning environments (Williams, 2013). Personalizing the learning activities using instruction that consider learners as the center of any educative processes is central to learning. Therefore, Bautista (2012) emphasized that learner who discovers procedures usually understand it as discovery and understanding supplement each other. Learners learn more rapidly and retain what has been learnt for a long time when he/she discovers it.

The role of the teacher in the Personalized-Learning Strategy is restricted to the provision of assistance to students in developing Personalized-Learning plans, as well as diagnosing the points of strength and weaknesses in their knowledge, and modifying the learning setting and the teaching process according to the needs of students, in addition to seeking to provide an original learning experience for the students (Bautista, 2012). The ultimate aim of a Personalized-Learning environment as opined by Williams (2013) and Bates (2014) is to create an educational system that responds directly to the diverse needs of individuals rather than imposing a ‘one size fits all' model on students. Personalized-Learning shifts the role of students from being simply a 'consumer' of education to a 'co-producer and collaborator' of their learning pathway (Bates, 2014). Bentley and Miller (2004) stated that Personalized-Learning Strategy actively engages students in the process of learning which ultimately leads to improved learning outcomes and learning experiences.

According to Houchens and Kalaivani (2014) opined that flexibility is one of the basic concepts related to the Personalized-Learning Strategy, because learning can occur at any time, in any place, and in any method. The purpose herein is to urge the students to be inventive and responsible for their own learning. Personalization of learning requires forming a unique relationship between the teacher and the student, the use of various tools and means, in order to support the learning of every individual learner. This requires flexibility in terms of time, place, and the pace of learning, and in which the student contributes to the identification of the direction and development of the learning process, and in which modern techniques are used in documenting the learning process and the use of rich sources of knowledge (Twyman & Redding, 2015). The use of Personalized-Learning Strategy for institutions enhances their reputation as one that values and supports individual students' learning. Personalized-Learning Strategy is used in this study to determine its effect on self-efficacy and academic performance of chemistry secondary school students in Mole Concept.

2.4.1 Models of Personalized-Learning Strategy

Inspired, at least in part, by psychological theories suggesting that learners can and should play an active role in selecting the direction, nature and goals of their own learning, various researchers and practitioners have developed models of Personalized-Learning Strategy. Classic examples include Keller's (1968) Personalized Systems of Instruction, Maria Montessori's

System of Child-Centered Learning, and various approaches to problem-based learning, while more contemporary models include Clark's Personalized-Learning instruction (2003).

2.4.1.1 Keller's Personalized System of Instruction(PSI)

Keller (1968) introduced Personalized System of Instruction and devised a means for personalizing college students' learning. There are five essential components in Keller's system of personalization: courses are self-paced; learners must demonstrate mastery at a level of 100% before advancing to the next unit; formal instructional methods, for example lectures and demonstrationare used only to provide motivation not to impart important information; there is an emphasis on concepts expressed by writing; and proctors as part of large teaching teams are used to allow for multiple testing opportunities for students on an individual basis. Kulik, Kulik and Cohen (1979) performed a meta- analysis of the research that had been conducted on Keller's personalized system of instruction (PSI) around the time it was first introduced. They examined the results of 72 different research projects, which studied 75 different courses taught using the PSI model and the conventional model respectively. The analysis was performed taking into consideration and compensating for the methodological differences among the studies examined, which would have affected the ability to make sound comparisons.

In studies that examined students' satisfaction, students reported that PSI courses were more rigorous, yet they enjoyed the classes more and the workload was more manageable. A few of the studies examined also considered students' performance on a follow-up examination administered sometime after course completion. Students who had used the PSI model performed significantly better on these retention tests than others who used the conventional method. Kulik, Kulik and Cohen (1979) also considered differences in course difficulty (introductory and upper-level courses), course discipline (humanities, social sciences, physical sciences, and life sciences), as well as institution type (major research universities, doctorate conventional granting institutions, liberal arts colleges, and community colleges) that existed among the studies examined. In light of these differences, PSI still offered superior results to teaching methods. The researchers also accounted for the possibility of instructor effects when assessing the data. Overall, researchers found that PSI enhanced student achievement and satisfaction.

In recent times, enthusiasm towards Keller's PSI (1968) has waned and there is little current research on the method. This has been due to the inherent difficulties with implementing the model in its purest sense adhering to the five components as set out by Keller. In spite of this, Eyrie (2015) conducted a review of the current state of research into the Keller model. Eyrie concluded that with the innovation surrounding educational technology there is a new shift in application of the model to web-based courses, which could prompt renewed focus on PLS.

2.4.1.2 Montessori Education(System of Child-Centred Learning)

In schools inspired by Maria Montessori's work with at-risk children (Shernoff, 2013), emphasis is placed on allowing students to independently explore the world around them embodied in the classroom. Activities are designed to allow for independence and autonomy, and also to appeal to students' interests to thereby produce intense levels of concentration. The ideas of Montessori are similar to Csikszentmihalyi's flow (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2013) which, as previously described, is characterized by concentration, interest, and enjoyment. Montessori emphasizes student interest and enjoyment. The intense concentration that characterizes flow is facilitated by allowing students to remain engaged in an activity for as long as their interests will facilitate, regardless of whether or not it is time for a designated break as would be stipulated by the traditional school schedule. In addition to promoting concentration, a typical Montessori classroom is designed to allow movement, collaboration, and a sense of order. Within it, students are encouraged to move around selecting activities of interest. The materials that students manipulate as part of a lesson are all carefully designed to not only spark interest but to also facilitate learning and most importantly produce enjoyment. The Montessori model also emphasizes the incorporation of movement into learning activities. The theoretical basis for this practice is the notion that “the body is an active entity that moves in concert with the mind” (Shernoff, 2013).

The goal of Montessori is to foster a child’s natural inclination to learn. Children if given the autonomy to select their own activities will seek out tasks that are within the zone of proximal development (Vygotsky, 1978) as these tasks will provide them with just enough challenge to create flow. Montessori teachers guide rather than instruct, providing each student with options for activities that meet his or her unique interests, needs, and developmental level (Shernoff, 2013). Since children are encouraged to pursue activities that interest them, they are more likely to develop a mastery-oriented approach to learning rather than a performance-oriented approach. This focus on mastery instead of performance is also facilitated by restricting the role of the teacher to casual observer instead of official evaluator. Much of the research on the effectiveness of the Montessori model has been focused on social development and school experience. Rathunde and Csikszentmihalyi (2005) reported that middle school students in a Montessori program felt more enthusiasm towards their academic work than did their counterparts in traditional schools. They also perceived the work they were doing as more important. Montessori students were more intrinsically motivated than traditional students and reported experiencing flow more frequently. Students enrolled in Montessori schools were more likely to regard their classmates as friends rather than associates. While the research connecting Montessori style education to academic outcomes such as achievement is somewhat inconclusive, several connections can be made between Montessori and improved performance in specific subject areas.

Dohrmann, Nishida, Gartner, Lipsky, and Grimm (2007) reported on a study they conducted in which they aimed to identify academic outcomes of high school students enrolled in a Montessori program at the elementary school level. The authors sampled a group of 144 students who had all attended one of two Montessori elementary schools in Milwaukee and then gone on to attend various traditional public high schools in the state. The researchers used a matched control group of demographically-similar students at the same high school who had attended non-Montessori elementary schools. Dohrmann, Nishida, Gartner, Lipsky, and Grimm (2007) observed that students who had attended a Montessori program performed better in the areas of math and science when compared to their peers. It should be noted that the students' performance in English and social studies was comparable to that of their matched peers who had attended traditional elementary schools. Dohrmann et al. suggested possible reasons for these results could be the differences in the amount of time allocated for studying English as compared with math at the elementary level. Researchers argued that 50 percent of instruction at the 1st and 3rd grade levels was in literacy.

Whereas, in the Montessori school model students are expected to allot equal amounts of time for mathematics as they do for language. Researchers also speculated that students tend to be more exposed to language development opportunities at home. These parental behaviors can enhance students' performance in the language arts. It should be noted that, the researchers identified several limitations to the study including failure to control variables such as parental motivation, involvement, and attitude towards education. They were also unable to gather information about the elementary school experiences of the members of the control group. These limitations could potentially have a profound impact on the results. In another study conducted by Lillard and Else-Quest (2006) Montessori students who had completed kindergarten and elementary school respectively were compared to students enrolled in traditional schools. Groups of 5- and 12-year-old children were randomly assigned to treatment and control groups. The treatment group consisted of students who had won the lottery to gain admission to the school, while students in the control group were those who had not been fortunate in the admissions lottery. By sampling in this way, researchers avoided ethical issues typically associated with experimental research in the social sciences. They also ensured there were no inherent differences in the parents of these students since both sets were parents seeking to have their children access Montessori style education. Lillard and Else-Quest (2006) observed cognitive differences in students in specific subject areas. At the end of kindergarten, Montessori students in the study performed better on standardized tests in the areas of mathematics and reading. At the end of elementary school, Montessori students composed essays more creatively employing complex sentences structure in their writing when compared with students in traditional schools. Both groups of students also exhibited more advanced social development for their respective ages when compared with peers in traditional schools.

2.4.1.3 Problem-Based Learning

Problem-based learning is an instructional strategy that was developed in medical education in the mid-1960s as a useful alternative to conventional teaching (Loyens, Magda, & Rikers, 2008). In this strategy, groups of students are presented with a real-world problem that they must work together to solve. There is a brief initial discussion of the problem, which has been shown to activate students' prior learning (Schmidt, Rotgans, & Yew, 2011). Following this discussion, students conduct research in areas related to the problem about which they would like to know more in order to better understand the issue and thereby resolve it. With problem-based learning, in addition to developing effective problem-solving skills, students are better able to collaborate with others and their intrinsic motivation to learn is enhanced. Students also engage in self-directed learning as they determine what to research.

2.4.1.4 Clarke's Personalized-LearningInstruction Model

Clarke (2003) described the Personalized-LearningInstruction model as learning procedure that takes into account the students' active participation in their learning from planning to execution of activities. Personalized-Learning instruction model of Clarke (2003) flowchart is presented in Figure 2.1. The model is described as follows:

1)Personal Learning Plans: Students and their teacher regularly assess student strengths, interests, and recent achievements so they can plan for further learning activities that challenge students to achieve more.

2)Portfolios: Students collect evidence of their learning from classes that show they are moving toward achieving their goals and meeting their expectations.

3) Student Presentations (or Exhibitions): Students explain the meaning of their work to a gathering of their friends, teachers, and guidance— receiving feedback on their progress and ideas for new investigations.

4) Assessment: From the presentation of the students, the teacher makes necessary correction and assess the students based on the content of the lesson.

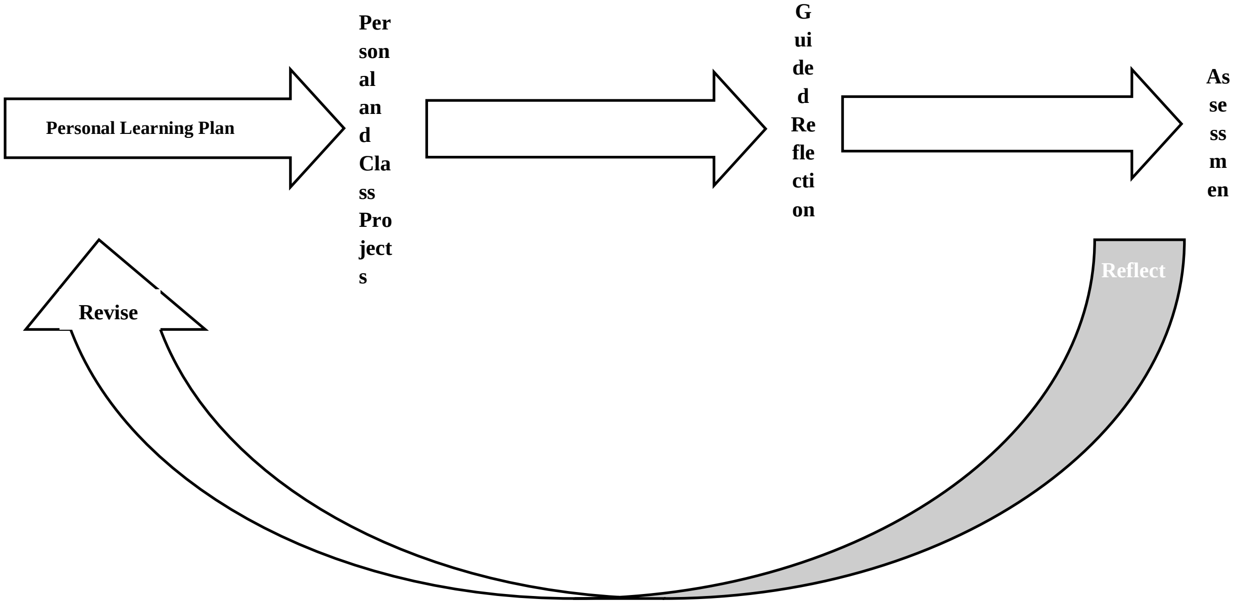

Figure 2.1: Personalized-Learning Strategy Model

Source: Adopted from Clarke (2003).

Therefore, this study adopted Personalized-Learning Instruction model of individualized learning as recommended by Keller (1968) and Clarke (2003).

2.4.2Personalized-Learning Strategyand Academic Performance

The use of computer and information technology has also been reported to provide Personalized-Learning support and feedback which help individual learners to improve their learning performance based on personal information, profiles, materials or learning portfolios (Walonoski & Heffernan, 2006). Such enhanced learning style as personalization of learning is positively correlated with academic performance (Sabourin & Lester, 2014) because it is found to aid students in reducing a task into its basic elements which they then reorganize into a meaningful whole (Cheema & Kitsantas, 2014) thereby improving their understanding and academic performance. Personalized-Learning Strategy according to Awofala and Nneji (2013) is more effective because students have the opportunity to work individually during their course self-learning, share views and opinions, and engage in brainstorming on problems. Personalized-Learning Strategy is particularly effective; when in collaboration with other approaches where the individual differences in the learners is taken care of.

The study of Gabriel, Osuafor, Cornelius, Obinna and Francis (2018) reported that students exposed to the Personalized-Learning Strategy performed better than those exposed to conventional method of teaching. The difference in performance for students taught using Personalized-Learning Strategy and conventional method was attributed to the fact that the students learn at their own pace, taking their time to understand difficult materials, ask questions, and make inquiry. Zywno and Waalen (2002) in their study found that Personalized-Learning Strategy increased students' performance and was significantly better than the conventional method. Another factor that may account for the positive effect of Personalized-Learning Strategy is that, the strategy guides learners better in their learning and assists them in recalling important information since they discover things by themselves (Awofala & Nneji, 2013).

Thus, planning lessons in such a way that will facilitate learners learning at their own pace and an approach which will take care of the individual differences arises according to Gabriel *et al.* (2018) would always be effective. The findings of Nnamani and Oyibe (2016) reported a significant effect on the students' achievement using Personalized-Learning Strategy. The findings of Neboh (2009) also noted that the use of learning activity package method of Personalized-Learning Strategy significantly affected students' achievement.

2.4.3 Personalized-Learning Strategyand Self-Efficacy

Several factors have been implicated to contribute to student Self-Efficacy and among these factors according to Bolliger and Martindale (2004) and Sahin (2007) is personalization of learning. Personalized-Learning environments according to Liu (2007) can give rise to increased Self-Efficacy that will in turn increase learner motivation and academic performance (Lim, Morris & Yoon, 2016). Students' Self-Efficacy affects learning experience and it is a viable measure of academic performance. Students with a higher level of satisfaction and Self-Efficacy has been found to be persistent in their learning which helps to maintain and improve retention and academic performance (Artino, 2007). Different lines of research have supported and reported positive relationship between self-efficacy and academic performance. The study of Moritz, Feltz, Fahrbach and Mack (2010) reported positive response in academic performance to improved self-efficacy. On the other hand, self-efficacy does not always relate positively to academic performance in school (Vancouver & Kendall, 2006) thus suggesting that there may be other factors that mediate between self-efficacy and academic performance like instructional strategies.

2.4.4Personalized-Learning StrategyandGender

Personalization of learning has been reported not to affect the academic performance of male and female as Nurretin and Ozlem (2009) reported that there were no significant differences between genders. No significant difference was observed between learners taught using Personalized-Learning and those taught using non-personalized materials and between genders (Chen & Liu, 2007).Gambari (2010), Yusuf and Afolabi (2010) and Gambari, Shitu, Daramola and James (2016) found no significant differences between gender of secondary school students when they were exposed to Personalized-Learning Strategy. Savio-Ramos (2015) conducted a study on algebra using Personalized-Learning Strategy and reported that there was no significant difference in the academic performance and self-efficacy of male and female students. The study of Agwu (2017) also observed no significant difference in the academic performance of male and female taught organic chemistry using Personalized-Learning Strategy.In a similar study conducted by Nnamani and Oyibe (2016) on the effect of Personalized-Learning Strategy on the academic performance of secondary school students in social study reported that female students performed better than their male counterpart. It is on this basis that this study investigates the effects of Personalized-Learning on Self-Efficacy and performance of chemistry secondary school students to see its effect on gender.

2.5Concept of Self-Efficacy

Self-efficacy was introduced by Bandura (1977) as an individual's belief in his or her capacity to produce specific performance and attainments. According to Ashford and LeCroy (2010), self-efficacy is asocial learning theorywhich has progressed into the Social Cognitive Theory. It emphasizes how cognitive, behavioral, personal, and environmental factors interact to determine motivation and behavior (Crothers, Hughes & Morine, 2008) which they concluded that self-efficacy and human functioning is the result of the interaction among all three of these factors. According to Golnaz (2011), self-efficacy refers to people's judgement about their capability to perform particular task and it increases the effort and persistence towards challenging task. Task control and active involvement of learners can be associated with high self-efficacy and improved academic performance. The work of Axtell and Parker (2013) stated that increased task control is associated with increased role breadth self-efficacy. A very important motivational concept to draw on in this endeavour is self-efficacy proposed by Bandura (1986) which refers to people's judgements about their capability to perform particular tasks. Barling and Beattie (1983) observed that task-related self-efficacy increases the effort and persistence towards challenging tasks, and therefore increases the likelihood that they will be completed. There is much evidence linking self-efficacy with actual behaviour. For instance, a recent meta-analysis of 114 studies showed a significant correlation between self-efficacy and work-related performance (Stajkovic & Luthans, 1998). Relationships between self-efficacy and contextual performance have also been found (Somech & Drach-Zahavy, 2000).

Self-efficacy has been found to be an important determinant of proactive behaviours. For instance, it has been found to be an important predictor of employee innovation (Axtell, Holman, Unsworth, Wall, Waterson & Harrington, 2010). Griffin, Parker and Neal(2012) found that self-efficacy was the strongest predictor of proactive performance relative to other predictors, and that other types of performance (task and adaptive performance) were influenced more by other antecedents. Other studies have also shown that self-efficacy is an important determinant of two types of proactivity: personal initiative (Fay & Frese, 2010) and taking charge (Morrison & Phelps, 2009).

Researchers have suggested that mastery leads to stronger and more generalized self-efficacy expectations in the learners (Bandura, Adams & Beyer, 1977). Parker (1998) argued that enactive mastery towards an expanded, proactive role is likely to be increased when, for example, the subjects are able to make autonomous decisions, use their abilities and work on challenging tasks. Thus, initiatives such as work design training, workplace communication, challenging assignments and involvement in improvement groups might be important facilitators of self-efficacy.

Certain work designs and structure of curriculum are likely to provide opportunities for self-efficacy enhancing experiences. Increased task, responsibility and decision-making authority over one’s immediate set of tasks (that is, task control) is likely to lead to feelings of increased personal control, which is crucial in building self-efficacy (Bandura, 1986; Bandura & Wood, 1989). Chou (2001), for example, found that training involving behavioural modelling resulted in consistently higher self-efficacy for a computer task than an instruction-based training method. One’s belief in the likelihood of goal completion can be motivating in itself (Van der Bijl & Shortridge-Baggett, 2012). Hence, self-efficacy refers to people's judgements about their capability to perform particular tasks. Task-related self-efficacy increases the effort and persistence towards challenging tasks; therefore, increasing the likelihood that they will be completed (Axtell & Parker, 2013).

Self-efficacy beliefs are an important aspect of human motivation and behavior as well as influence the actions that can affect one's life. Regarding self-efficacy, Bandura (1995) explains that it refers to beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations. The basic principle behind self-efficacy theory is that individuals are more likely to engage in activities for which they have high self-efficacy and less likely to engage in those they do not (Van der Bijl & Shortridge-Baggett, 2012). According to Gecas (2004), people behave in the way that executes their initial beliefs; thus, self-efficacy functions as a self-fulfilling prophecy. More simply, self-efficacy is what an individual believes he or she can accomplish using his or her skills under certain circumstances (Snyder & Lopez, 2007). And according to Lunenburg (2011) self-efficacy is thought to be a task-specific version of self-esteem.

Bandura (1977) outlined four sources of information that individuals employ to judge their efficacy: performance outcomes (performance accomplishments), vicarious experiences, verbal persuasion, and physiological feedback (emotional arousal). These components help individuals determine if they believe they have the capability to accomplish specific tasks. The study of Redmond (2016) stated that individuals form their self-efficacy beliefs by interpreting information from four sources: the most influential source is the interpreted result of one's previous performance, or mastery experience. In addition to interpreting results of their actions, people form their self-efficacy beliefs through the vicarious experience of observing others. Individuals then also create and develop self-efficacy beliefs as a result of social persuasions they receive from others and somatic and emotional states such as anxiety, stress, arousal, and mood states (Pajares, 2009). Williams and Williams (2010) note that individuals with high levels of self-efficacy approach difficult tasks as challenges to master rather than as threats to be avoided. According to Redmond (2010), self-efficacy is also influenced by encouragement and discouragement pertaining to an individual's performance or ability to perform because these activities can cause agitation, anxiety, sweaty palms, and/or a racing heart.

Self-efficacy as a concept is related to certain ideologies; personality trait which is considered a fairly stable pattern of psychological behavior (thoughts, feelings, and actions) and influences how one will act in response to diverse circumstances (Quinn, Faerman, Thompson, & McGrath, 2003). Personality does not determine behavior; behavior arises in a context, such as work. According to Berens, Cooper, Ernst, Martin, Myers, Nardi and Smith (2010), "personalities reflect the requirements of the contexts as well as our innate tendencies and how we have adapted to these contexts over time". In other words, an individual's behavior is determined by the requirements of the situation. Self-efficacy is a related but subtly different from personality characteristic, hence Griffin and Moorhead (2010) opined that self-assessments of ability contribute to self-efficacy so does the individual's personality.

Self-esteem and self-efficacy are often thought of as being synonymous, however they vary greatly. Self-efficacy differs from self-esteem in that it's a judgment of specific capabilities rather than a general feeling of self-worth (Beck, 2008). Therefore, an individual who has high self-efficacy and is successful in most of the tasks he/she undertakes will most likely develop high self-esteem as stated by Redmond (2016). Alternatively, self-esteem could also influence self-efficacy.Self-efficacy theory also utilizes an important construct of equity theory. Like equity theory, motivation can be influenced by how an individual perceives themselves when compared to another. The difference between the two theories is that equity theory illustrates that an individual's motivation is influenced by the perceived equality of input/output ratios of the comparison-other, where in contrast, self-efficacy theory predicts that an individual's motivation can be influenced by the positive/negative vicarious experiences of the comparison-other. In truth, both theories have been proven to be correct (Redmond, 2016).

The expectancy theory, also known as the VIE (expectancy, instrumentality, and valence) theory, is based on the beliefs that an individual’s effort will lead to performance, which in turn, will lead to a specific outcome (Beck, 2008). Comprehensively, self-efficacy is based on an individual’s belief about their ability to perform specific behaviors. Expectancy theory explores how rewards affect motivation, whereas self-efficacy explores how beliefs about capabilities affect motivation. According to Bandura (1997), “People take action when they hold efficacy beliefs and outcome expectations that make the effort seem worthwhile. They expect given actions to produce desired outcomes and believe that they can perform those actions." To successfully achieve the desired outcome, individuals must possess the necessary skills as well as a buoyant self-belief that they are capable of controlling the specific situational factors (Bandura, 1999). People with high self-efficacy are more likely to respond with renewed effort (expectancy) when feedback shows that they are not reaching their goals by developing more successful strategies (Smith& Hitt, 2005). However, individuals with low self-efficacy, given the same circumstancesmay perform poorly because their low self-efficacy impairs their motivation and effort.

Self-efficacy constructive theory believes that one when faced with a difficult task, people who have high self-efficacy will face the challenge as something to be learned and mastered as their interest and motivation in mastering the task will drive them to succeed in their difficult, yet approachable goal (Pajares & Schunk, 2001). Similarly, while striving to complete a challenging task or difficult goal, individuals with high self-efficacy may face failures or setbacks, but they will not give up (Redmond, 2016). Where people with low self-efficacy may decide the task is impossible, people with high self-efficacy strive to develop a higher amount of knowledge and increase their effort in order to overcome their failures and setbacks (Pajares & Schunk, 2001). People with high self-efficacy as stated by Bandura (1995) are more likely to set more challenging goals for themselves and be more committed to the goal, which enhances self-efficacy. Researchers have demonstrated the positive effects of self-efficacy beliefs on effort, persistence, goal setting, and performance (Pajares, 2009). Therefore, this study seeks to investigates the effects of Personalized-Learning Strategyon self-efficacy of chemistry students in Mole Concept.

2.5.1Self-Efficacy and Academic Performance in Science

Self-efficacy according to Lunenburg (2011) has influence over people's ability to learn, their motivation and their performance, as people will often attempt to learn and perform only those tasks for which they believe they will be successful. Judgments of self-efficacy according to Vander - Bijl and Shortridge-Baggett (2012) are generally measured along three basic scales: magnitude, strength, and generality.Self-efficacy magnitude measures the difficulty level (as to how easy, moderate, and hard) an individual feel is required to perform a certain task (Van der Bijl & Shortridge-Baggett, 2012). Self-efficacy strengthrefers to the amount of conviction an individual has about performing successfully at diverse levels of difficulty (Van der Bijl & Shortridge-Baggett, 2012). Generality of self-efficacyrefers to the degree to which the expectation is generalized across situations (Lunenburg, 2011). The basic idea behind the self-efficacy theory is that performance and motivation are in part determined by how effective people believe they can be (Redmond, 2010).

Self-efficacy theory states that the combination between the four factors of developing self-efficacy and three assessment processes used to interpret self-efficacy will determine the level of self-efficacy which directly affects the performance outcomes. The three assessment processes for self-efficacy are the analysis of task requirements, attributional analysis of experience, and assessment of personal and situational resources/constraints (Gist & Mitchell, 2010).According to Redmond (2016) academic success depends fully on the three assessment processes of self-efficacy. Analysis of task requirements, which is the amount of determination that a student has to do whatever it takes to perform/complete a task; attributional analysis of experience which is the personal perception and understanding that a student has in regards to why they accomplished a specific performance level; and assessment of personal and situational resources/constraints which is the student's consideration of personal and situational factors that may affect their education. Studies exploring feedback and its role on self-efficacy and performance were reported in an American Psychological Association article. Varying ranges of feedback were provided to participants with either little feedback or a wide range of feedback. The results indicate that the higher, more detailed levels of performance feedback positively related to subsequent performance (Beattie, Woodman, Fakehy& Dempsey, 2015). Levan (2010) stated that self-efficacy can be improved by spending time around people who are positive and can build you up through verbal persuasion to improve performance and stay clear of those who may want to bring you down.

Higher self-efficacy according to Redmond (2010) has been found to improve academic performance, habitual hard work and perseverance than individuals with low self-efficacy. Generally, individuals who perform well develop high self-efficacy (Davis, Fedor, Parson, & Herold, 2010; Redmond, 2010). Self-efficacy beliefs also contribute to performance since they influence thought processes, motivation, and behavior (Bandura, 2006) and fluctuations in performance may be explained by fluctuations in self-efficacy. Yazachew (2013) stated that low self-efficacy has been associated to lower academic performance in students.

According to Diane (2013) scores greater than or equal to 60 were classified as high self-efficacy, scores from 31 to 59 were classified as moderate self-efficacy, and scores less than or equal to 30 were classified as low self-efficacy. The result of the study by Yazachew (2013) on the relationship between the academic performance and self-efficacy level of students showed significant influence of self-efficacy on academic performance hence concluded that students' achievement is highly related to their inbuilt self-efficacy. On the contrary, Vancouver, Thompson, Tischnerand Putka (2012) in their studies to examine how high self-efficacy would relate to anindividual's performance. The findings of the study reported that when a person has high level of self-efficacy, this did not mean they had a high level of performance and concluded that it could lead to a low level of performance. Negative effect could exist between self-efficacy and performance when self-confidence is also considered. Therefore, having high levels of perceived self-efficacy may cause a person to set higher goals, but such can also reduce the motivation to reach the goals (Vancouver *et al*., 2012). Hence, the study investigates the effect of Personalized-Learning on self-efficacy and academic performance of secondary school chemistry students in Mole Concept.

2.6Gender and Academic Performance in Science

Academic performance is a major variable in students' learning. Academic performance according to Okeke (2010) is the scholastic outstanding of a student at a given moment which states the individual's intellectual abilities that can be measured by grades obtained from examinations. Performance is a concept that define the exhibition of knowledge attained or skills developed by students in the school subject usually designed by test scores or by marks assigned by teachers (Ogundukun & Adeyemo, 2010). Performance in academics have been linked to instructional strategiesand gender of the learners(Atadoga & Onaolapo, 2008; Usman, 2010; Ameh & Dantani, 2012; Atadoga & Lakpini, 2013).The concept of "gender" in teaching and learning process has attracted the attention of many researchers who considered different aspects of the concepts. Gender according to Pollard and Morgan (2002) refers to the socially constructed expectation for male and female behaviour which prescribes a division of labour and responsibilities between males and females granting of different rights and obligation to them. This in turn affects greatly their level of performance in the society. Studies on the attitude of different gender revealed that male show more positive attitudes toward science than females (Prokop, Tuncer & Chuda, 2007; Olagunji & Abiona, 2008) which accounts for the less participation and contribution of women in science and technology. Different Researches have found gender imbalance as it relates to academic performance; some studies revealed no significant differences in the performance of male and female students when exposed to the same treatment and conditions of learning (Raimi, 2010; Sparks, 2013; Olasheinde & Olatoye, 2014; Etiubon & Udoh, 2016). Researchers such as (Olagunji & Abiona, 2008; Olorukooba, Lawal & Jiya, 2012; Obeka, 2013) recorded significant better academic performance in sciences in favour of male. Others have reported better performance in favour of female science students (Haruna, 2000; Patrick & Ezenwa, 2000; Mari, 2001; Maikano, 2009; Usman, 2010).

The report of Ekeh (2004) in a study observed that male students performed significantly better than their female counterparts in mathematics. Oludipe (2012) also contend that male students achieve higher than their female counterparts in science. The research conducted on gender disparity on academic performance in mathematics of Senior Secondary School reported that academic performance of male is higher than that of females (Young & Fisler, 2000). The study carried out by Usman (2008) to compare the relationship between students' gender and their academic performance in biology revealed that senior secondary male biology students perform well in any rigorous work than their female counterpart. Self-efficacy is important to help the learners to have the belief that they can perform tasks and achieve their set goals according to Zimmerman and Cleary (2006). The learners with less successful strategies as stated by Collins (2011) are the individuals that have low level of self-efficacy. Self-efficacy plays a crucial role in self-regulation because it influences the learners' abilities to judge their task performance and goal achievement (Collins, 2011). Also, teacher's feedback to students increases their self-efficacy (Zimmerman & Cleary 2006) which can empower for improved performance.

Gender influence on student's academic performance in science have varying conclusions by many researchers. Contrary to better performance by male, a study conducted by Mari (1994) on understanding of science process and its relationship to academic performance in integrated science" argued that female perform better than male in integrated science. Bichi (2008) worked on "Effects of Gender on Historically Enriched Curriculum on academic performance in Evolution Concept Using Senior Secondary Biology Students and found disparity among gender in support of female. The findings of Okwo and Otubah (2007) showed that female students performed better than their male counterparts in basic science. Etiubon (2011) also concluded that female achieved more than male in chemistry subject and that female learners show some superiority over male learners. The studies of (Okwo &Otubah ,2007; Etiubon, 2011) observed that female students performed significantly better than their male counterparts in chemistry and physics.

However, in contrast to those research findings, Mari (2001) supports this assertion in his study on entry qualification and academic performance. The result showed that male and female students admitted with the same entry qualification have no significant difference in their academic performance. Haruna (2008) revealed that there is no significant difference in the academic performance of gender in chemistry. Maikano (2009) found no significant difference in the academic performance between male and female students taught ecological concepts using the outdoor laboratory instructional strategy. Raimi (2010) found no significant difference among gender in students' academic performance and retention in biology. In addition, Usman (2010) states that outdoor laboratory method enhances academic performance of students in spite of their gender. Kajuru and Ado (2012) established that Innovative Teaching Strategies with Integrated Resource materials enhance academic performance of both male and female students. Etiubon and Udoh (2016) reported no significant influence of gender on students' academic performance when taught solubility using Practical Activities and Manual in chemistry. The study carried out by Ajayi and Ogbeba (2017) on effect of gender on senior secondary chemistry students' achievement using hands-on activities also reported no significant difference in mean achievement scores of male and female chemistry students in stoichiometry. However, in another study carried out by Akala (2010) on gender differences in students' achievement in chemistry reported that male students performed better than their female counterparts in Chemistry Achievement Test (CHAT). Therefore, Personalized-Learning Strategywas used in this study to determine its effect on self-efficacy and academic performance of male and female senior secondary chemistry students in Zaria, Kaduna State, Nigeria.

2.7Gender and Self-Efficacy in Science

Gender describes social and historical constructs for masculine and feminine roles, behaviours, attributes and ideologies, which connote some notion of biological sex (Azikiwe, 2011). This is linked to their self-efficacy level that also influence their achievement in the society. The role of student's self-efficacy in empowering academic outcomes has been proven according to Bandura (2006) and Collins (2011) where students with high level of self-efficacy often persevere longer with tasks, and are more likely to set and monitor their goals. Several research studies (Pintrich & DeGroot, 2010; Tippins, 2010; Smist & Owen, 2014; Kinsella, 2015) observed that female students often have lower self-efficacy in Mathematics and Science compared to their male counterparts. female capabilities are undermined in many cultures by sex-role stereotypes which holds that female are not as able as male, especially in disciplines related to mathematics and other science related courses (Bandura, 2006). Another contributing factor is the lower level of expectations that parents, teachers, counselors and the society at large often hold for female, which can be discouraging (Astin & Sax, 2006; Bandura, 2006). Confidence is strongly correlated to students continuing in mathematics and science courses (Jewett, 1996; Astin & Sax, 2006).

In general, male students display more positive attitudes towards careers in science than females (Smist, Archambant & Owen, 2011). Regardless of gender therefore, more career options, including potentially higher career aspirations, are considered by those possessing a high degree of self-efficacy (Bandura, 2006) whether male or female because self-efficacy according to (Kennedy, 2011) predict choice of career. In two separate studies of high school Mathematics students by Miller, Greene, Montalvo, Ravindran and Nichols (2011), it was found that females had lower perceived self-efficacy and ability levels than males.

In a study conducted on the seventh-graders, higher science self-efficacy was found in males (Pintrick & DeGroot, 2010; Tippins, 2010) while in college general chemistry class, a statistically significant finding was reported with males scoring higher than females in science self-efficacy for laboratory skills (Smist, 2010). The study also reported that females had lower self-efficacy scores than males for the sciences; however, females scored higher in self-efficacy than males for biology (Smist, Archambant & Owen, 2011) which may be attributed to the reading nature of biology unlike chemistry, physics and mathematics that cannot be read but studied.The traditional cultural attitude towards the female gender which restricts them from activities considered masculine according to Okeke (2010) determines male and female access to environmental stimulations which has been reported to influence their self- efficacy in favour of the males (Eze & Agboma, 2008). Although gender differences seem to play a role in the level of the student’s self-efficacy, Jacobs, Lanza, Osgood, Eccles and Wigfield (2012) in a study on gender differences in self-efficacy showed inconsistent result. A study by Pajares (2013) concludes that although grade nine female students obtained better writing scores, the male students showed a higher level of self-efficacy than the female students. Jacobs *et al*. (2012) concludes that female students have higher self-efficacy than males from kindergarten through grade twelve in mathematics.Therefore, in this study, Personalized-Learning Strategy is used to see whether it will boost the self-efficacy of male and female students in chemistry.

2.8Overview of Similar Studies

A number of studies have been carried out on the use of Personalized-Learning Strategy for teaching and learning.The following empirical studies are related to the present study:

Akinsola and Awofala (2009) investigated the effect of Personalized Print-based Instruction on Achievement and Self-efficacy regarding Mathematics word problems among senior secondary students in Lagos State, Nigeria. The study employed Quasi-experimentalinvolving pretest posttest control group design. The study comprised of a total population of 500 students, out of which 320 students were sampled. The study employed two instruments:Mathematics Word Problem Achievement Test (MAWPAT)and Self-Efficacy Questionnaire (SEQ) for data collection. The data collected were analyzed using independent samples t-test at $P \leq 0.05$ levels of significance. The results showed that significant differences existed in the Mathematics Word Problem Achievement Test and Self-Efficacy beliefs of personalized and non-personalized groups. Significant differences were also reported for male and female students of personalized groups and male and female students of non-personalized groups. The study of Akinsola and Awofala (2009) is related to the present study in that they determine the effect of Personalized-Learning Strategy on academic performance and self-efficacy of senior secondary school students using personalized (experimental) and non-personalized (control) groups, both studies used quasi-experimental research design. The study of Akinsola and Awofala (2009) differs with the current study in that the study was carried out in mathematics word problem while the present study was carried out in chemistry Mole Concept. Akinsola and Awofala (2009) used a sample size of 320 from a population of 500 students, the instruments Mathematics Word

Problem Achievement Test and Self-Efficacy Questionnairewere used for data collection and data collected were analyzed using t-test statistic while the present study used a sample size of 143 from a population of 6,527 students,Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) were used for data collection and data collected were analyzed using t-test statistical tool. Therefore, this study filled the gap of self-efficacy which was not captured in the study reviewed.

Bautista (2012) examined the effect of Personalized Instruction on academic achievement of students in Physics in General Education Department of Cagayan Valley Computer and Information Technology College, Inc., Santiago City, Isabela, Philippines. The study employed quasi-experimental involving pretest posttest control group design. The study comprised of a total population of 250 students. The sampleconsists of seventy-eight (78) Physics students. The participants of the study were divided into two groups, the experimental group which were taught using the personalized system of instruction and the control group which were taught using the traditional teaching method. The study used Teacher-made Achievement Test as instrument for data collection. The data collected were analyzed using frequency counts, mean, percentage and ANCOVA. The findings revealed significant differences in the achievement between the experimental and control groups. The significant differences in the achievement are in favour of the experimental group. The study of Bautista (2012) is related to the present study in that they determined the effect of Personalized-Learning instruction on academic performance. Both studies employed quasi-experimental research design. The study differs in self-efficacy, population, sample size, number of research question, null hypotheses, instruments, subject and location.The study of Bautista (2012)used a sample size of 78 Physics students, while the present study used a sample size of 143 Chemistry students.

The study reviewed used teacher-made achievement test as instrument for data collection. The data collected were analyzed using frequency counts, mean, percentage and ANCOVA, while the present study employed two instruments; Mole Concept Performance (MCPT) and Self-Efficacy Questionnaire (SEQ) as instruments for data collection. The data collected were analyzed using t-test statistical tool. Furthermore, the study considered academic achievement as the only variable while the psychological variable such as self-efficacy was not considered. The study reviewed was carried out among Physics students, while the present study was carried out among chemistry students. Hence, this study filled the gap of self-efficacy, subject and location.

Savio-Ramos (2015) investigated the Efficacy of Personalized-Learning in Algebra as a remediation toolamong students of Arizona University, United State. The study employed quasi experimental research design. A total of 117 high school students in grades 10 through 12 participated on a voluntary basis. They had previously taken an introductory Algebra course and were now enrolled in a different mathematics course. The students were assigned to one of two conditions: (a) the computer-based multimedia learning environment on the Personalized-Learning platform known as Personalized-Learning and (b) the same learning environment without the Personalized-Learning platform. In addition to completing a pre-test and posttest, participants were administered Attitudinal Test (AT). Results indicated no knowledge gains in either group at the post-test assessment. Furthermore, analyses by gender and race also did not reveal any significant differences among the groups. However, findings revealed that, students exposed to the Personalized-Learning environment had more positive perceptions towards Personalized-Learning than those exposed to non-Personalized-Learning. The study of Savio-Ramos (2015) is related to the present study in that both examined the effect of Personalized-Learning Strategy on performance of secondary school students.

The study differs in the area of self-efficacy, population, sample size, sampling techniques, instrument, statistical tool, subject and location.The study of Savio-Ramos (2015) used a sample size of 117 grade 10-12 students in algebra while the present study used a sample size of 143 SS2chemistry students in Mole Concept.The study used one instrument; Attitudinal Test (AT) as instrument for data collection. The data collected were analyzed using independent sample t-test, while the present study used two instruments; Mole Concept Performance (MCPT) and Self-Efficacy Questionnaire (SEQ) as instruments for data collection. The data collected were analyzed using t-test statistical tool.The study reviewed was carried out in United State of America, while the present study was carried out in Kaduna State, Nigeria. This study filled the gap of self-efficacy and location.

Ferhat and Mehmet (2016) examined the effect of PersonalizedInstruction System on the academic achievement of students of Software Engineering Department of Technology Faculty in Turkey. The pretest-posttest control group experimental design was used in the study. The experimental group received education with Personalized-Learning Instruction Portal while the control group received education in traditional learning environment. The study comprised of a total population of 350 students, out of which 60 students were sampled using simple random technique. Academic Achievement Test (AAT) was used for data collection. In order to test the research hypotheses, data obtained from the data collection tools were analyzed using frequency, percentages, and independent t-test at $P \leq 0.05$ levels of significance. Based on the results, no significant difference was found between the groups in terms of the pretest. On the other hand, significant differences were found between experimental and control group in terms of the posttest. It was concluded that Personalized-Learning portal had positive effect on the students' learning when used in combination with traditional learning environment. The study is similar to the present study as both examined the effects ofPersonalized-Learning Strategy on academic performance, two groups were also used; personalized-instruction (experimental) and non-personalized-instruction (control) groups.

The study reviewed is different from the present study in the area of self-efficacy, population, sample size, instrument, subject and location.The study reviewed hada sample size of 60, Academic Achievement Test (AAT) was used as instrument for data collection and data collected were analyzed using frequency distribution, percentages and t-test statistics while the present study had a sample size of 143 students, Mole Concept Performance Test (MCPT) and self-efficacy questionnaire were used for data collection and data obtained were analyzed using mean, standard deviation and t-test statistics. Therefore, this study filled the gap of self-efficacy and location.

Swan (2017) examined the effect of Personalized-Learning and its' effectiveness on Understanding and practice in College of Education, Health and Human Development, University of Canterbury, New Zealand. The study employed quasi-experimental design involving pretest and posttest control group design. A total population of 250 students were found in the area,out of which fifty (50) Physics students were sampled. The participants of the study were divided into two groups, the experimental group which were taught using the personalized system of instruction, and the control group which were taught using the traditional teaching method. The findings revealed significant differences in the achievement between the experimental and control group. The significant difference in the achievement was in favour of the experimental group. The study of Swan (2017) is related to the present study in that both determine the effect of Personalized-Learning instruction. Both studies employed Personalized-Learning instruction and quasi-experimental research design. The study differs in terms of performance, population, sample size, self-efficacy, instrument as well as location.The study had a sample size of 50 Physics students, while the present study used a sample size of 143 chemistry students. The study was carried out in College of Education, Health and Human Development, University of Canterbury, New Zealand, while the present study was carried out among secondary school Chemistry students in Zaria Education Zone, Kaduna State, Nigeria. This study filled the gap of performance, self-efficacy,subject and location which were not captured in thestudy reviewed.

In a recent study conducted by Alalwneh and Alomari (2018), the study examined the Impact of Personalized Teaching Strategy on the Achievement of the students of Vocation in Irbid University college, Irbid. The study employed quasi-experimental research design involving pretest and posttest control group. A sample which consists of (62) female students was selected purposefully from among the students of Irbid University college, which is a branch of the Balqa' Applied University in the academic year 2017/2018. The participants of the study were divided into two groups, the experimental group which was taught using the personalized system of instruction, and the control group which was taught using the traditional teaching method. The descriptive analytical method was used in order to answer the research questions and the hypotheses were tested using independent sample t-test at $P \leq 0.05$ levels of significance. Results of the study showed significant differences in the achievement between the experimental and control group. The study reviewed is similar to the present study in the sense that both studies used personalized teaching strategy, research design (quasi-experimental), performance and statistical tool. The studies differ in the area of self-efficacy, gender, population, sample size, instruments, subject and location. The study reviewed used a sample size of 62 female students, while the present study used a sample size of 143 male and female students.

The study reviewed used one instrument; Vocation Achievement Test (VAT) for data collection, the data collected were analyzed using independent sample t-test at P≤0.05 levels of significance, while the present study used two instruments; Mole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ) and the data collected were analyzed using independent samples t-test at P≤0.05 levels of significance. Furthermore, the study considered academic achievement of female students as the only variable tested, whereas variable such as self-efficacy was not considered, while the present is interested in the self-efficacy and academic performance of male and female students. The study was carried out among students of vocational courses in Irbid University college, while the present study was carried out among secondary school Chemistry students in Zaria Education Zone, Kaduna State, Nigeria. Therefore, this study filled the gap of self-efficacy, gender and location.

Jacobson (2010) carried out a study on the Effect of Instruction in Metacognitive Self-assessment strategy on senior secondary school students' Chemistry Self-efficacy and Achievement in Port-Harcourt Education Zone. A non-equivalent control group pretest and posttest design involving one treatment and one control group was adopted. The population comprised of 500 students. A total of 192 SS 2 students from Port-Harcourt Education zone were used for the study. Three instruments; Chemistry Achievement Test (CAT), Self-Assessment Scale (SAS) and Chemistry Self-efficacy scale (CSS) were adopted, validated and used for data collection. The data generated were collated, organized and analyzed using mean and standard deviation in order to answer the research questions and a two-way Analysis of Covariance (ANCOVA) for testing the null hypotheses. The results of this study showed that instruction in metacognitive self-assessment strategy significantly improved the Chemistry achievement of secondary school students and also significantly enhanced their self-efficacy. The study of

Jacobson (2010) is similar to the present study in that both studies employedperformance, quasi-experimental design and self-efficacy of chemistry secondary school students, but differs in areas of Personalized-Learning, metacognitive self-assessment, population, sample size, instruments and statistical tool.

The study reviewed had a sample size of 192 while the present study a sample size of 143 students. The study reviewed adopted Chemistry Achievement Test (CAT), Self-Assessment Scale (SAS) and Chemistry Self-efficacy Scale (CSS) as instruments for data collection. Data collected were analyzed using mean, standard deviation and two-way Analysis of Covariance (ANCOVA) while the present study usedMole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) as instruments for data collection. Data collected were analyzed using t-test statistic. Furthermore, the study was carried out among secondary school chemistry students in Port-Harcourt, while the present study was carried out among secondary school chemistry students in Kaduna State, Nigeria. Therefore, this study filled the gap of Personalized-Learning which was not captured in the study reviewed.

Yazachew (2013)investigated the level of students' self-efficacy, gender difference in self-efficacy and achievement among second year students in Analytical Chemistry I (ACI) at Debre Markos College of Teacher Education (DMCTE) in Ethopia. The study employed correlational research design. A total population of 300 students were found in the area, out of which196 students were sampled for the study. Self-efficacy survey data were gathered by Likert scale questionnaire. By using inferential statistics (independent sample t-test at $P \leq 0.05$ levels of significance), difference of self-efficacy and achievement in gender was calculated and by using Pearson correlation, the relationships between self-efficacy and achievement were investigated. The analysis of the data indicated that students' level of self-efficacy is medium (50.08), and there is no significant difference in the self-efficacy between sexes (t (98) = 0.161, $p>0.05$), but there is a statistically significant difference in achievement between sexes (t (98) = 0.68, $p< 0.05$) and also a significant relationship exists between self-efficacy and achievement ($r=0.385$, at 0.01 level with 98 degree of freedom). The study of Yazachew is similar to the present study in that both studies were carried out in chemistry. Both studies used performance, self-efficacy and gender, but differs in Personalized-Learning, population, sample size, instruments and statistical tools. The study had a sample size of 100 students, while the present study used a sample size of 143 students.

The study used two instruments; Self-efficacy Questionnaire and Chemistry Achievement Test for data collection. Data collected was analyzed using Pearson Product Moment Correlation (PPMC) statistic, while the present study usedtwo instruments; Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) for data collection. Data collected were analyzed using independent sample t-test at $P\leq0.05$ levels of significance. The study reviewed employed correlational research design, while the present study used quasi-experimental research design. The study was carried out in Debre Markos College of Teacher Education (DMCTE), while the present study was carried out among secondary school chemistry students in Kaduna State, Nigeria. Therefore, this study filled the gap of Personalized-Learning Strategy and location.

Lames (2014)determined the Effects of Metacognitive Prompted Reflection for Enhancing Students’ Metacognitive Awareness and Self-efficacy in Physics and Mathematics classes used 184 high school students in a K-12 private school in Dubai, the United Arab Emirates. The study employed a quantitative research approach using pretest-posttest quasi-experimental design. The study comprised of 230 students, out of which 184 students were sampled. Data were collected using the Self-Efficacy and Metacognition Learning Inventory (SEMLI-Math & SEMLI-

Physics) as a pretest and posttest, and subjected to descriptive and inferential statistics of both metacognitive awareness and self-efficacy. The questionnaire was piloted with sixty-two Grade 12 students from another American curriculum school. The reliability result of Cronbach's-Alpha test = 0.939 indicated a high level of internal consistency for the 30 items. Data analysis revealed that prompted reflections affected the students' metacognitive awareness and self-efficacy positively. There was significant improvement in metacognitive awareness and self-efficacy of students in the experimental groups except the physics groups which showed little improvement in self-efficacy. The study is related to the present study in that, it is built on finding the effect of Personalized-Learning Strategy on self-efficacy of chemistry secondary school students in Mole Concept. It also seeks to find out discrepancies or otherwise with the findings of Lames (2014). This study also seeks to determine the relationship that exist between chemistry students' self-efficacy and their academic performance in Mole Concept. Similarly, the study seeks to find out the effect of Personalized-Learning Strategy on self-efficacy of male and female chemistry students in Mole Concept. Both studies used self-efficacy and quasi-experimental design.

However, the difference between the present study with that of Lames (2014) is that, his study focused on physics and mathematics in a private high school in Dubai while the present study focuses on chemistry secondary school students in public co-educational schools in Kaduna State, Nigeria. The study used a sample size of 184 subjects and employed Self-efficacy Metacognition Learning Inventory (SEMLI) for data collection, while the present study useda sample size of 143 students.The present study used two instruments; Mole Concept Performance Test (MCPT)and Self-efficacy Questionnaire (SEQ) for data collection. Data collected were analyzed using independent sample t-test at $P \leq 0.05$ levels of significance. The study reviewed investigated metacognitive awareness and self-efficacy of Physics and Mathematics students, while the present study investigated impact of Personalized-Learning Strategy on self-efficacy and performance. Therefore, this study filled the gap of Personalized-Learning, performance and location.

Mohammed (2016) examined the Relationship between AchievementMotivation, Self-efficacy and Academic Performance among NCE students of colleges of education in Kaduna State, Nigeria. Survey research design was adopted in the study. The population of the study was made up of 5,707 NCE II students and the sample of the study was 361 students randomly selected. The study was guided by seven objectives, seven research questions and seven null hypotheses. Achievement Motivation, Self-efficacy Scales and students CGPA were used as instruments for data collection. Mean, Standard Deviation, Pearson Product-Moment Correlation (PPMC) was used to test the null hypotheses that guided the study. Resultof the study revealed that significant relationship existsbetween achievement motivation and academic achievement among NCE II students (r=.432, p=.002). Self-efficacy was found to have significant relationship with academic achievement (r=.230, p.014). Significant relationship exists between achievement motivation and self-efficacy (r=.363, p=.000). Significant relationship was found between achievement motivation and self-efficacy among art students (r=.683, p=.000). Significant relationship exists between achievement motivation and self-efficacy among science students (r=.477, p=.000). Significant relationship exists between achievement motivation and self-efficacy among male students (r=.588, p.000). Finally, significant relationship was also found between achievement motivation and self-efficacy among female students (r=.792, p= .001). The study of Mohammed (2016) is similar to the present study in terms of self-efficacy and academic performance, but differs in the area of Personalized-Learning Strategy, sample size, population, number of research questions, null hypotheses and research design. The study had a sample size of 361 students, while the present study had a sample size of 143 students. The study reviewed employed Survey research design, while the present study employed Quasi-experimental research design. The study reviewed used three instruments; Achievement Motivation, Self-efficacy Scales and students CGPA for data collection. Mean, Standard Deviation, Pearson Product Moment Correlation was used to test the null hypotheses, while the present study employed two instruments; Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ)for data collection. Data collected were analyzed using independent sample t-testat $P \leq 0.05$ levels of significance. The study was conducted among NCE students of colleges of education in Kaduna State, while the present study was conducted among secondary school chemistry students in Zaria Education Zone. Hence, this study filled the gap of Personalized-Learning Strategyand location.

Dangana (2017) investigated the impact of Inquiry-Based Instruction on Self-efficacy and Understanding of Nature of Science among NCE Biology Students in Lafiagi, Kwara State, Nigeria. The study adopted quasi-experimental involving pretest posttest experimental control groups design. The population of the study comprised of all the NCE I Biology students of three State Colleges of Education in Kwara State with the population of two thousand two hundred and seven (2207). The sample consisted of ninety (90) NCE I Biology students that were drawn from two colleges of education with forty-five (45) from each colleges of education from the population of one thousand four hundred and sixty-seven (1467) using table of randomization.Nature of Science Understanding Test (NOSUT) and Natureof Science Self-efficacy Questionnaire (NOSSEQ) were used for data collection. Data obtained were analyzed using mean and standard deviation to answer the stated research questions while the hypotheses formulated were subjected to test using independent sample t-test statistics at $p \leq 0.05$ levels of significance, while Pearson Product Moment Correlation Coefficient (PPMC) was used in determining the relationship between the groups. From the result obtained the hypothesis one, two and four were rejected while hypothesis three was retained. The findings revealed that understanding of nature of science and student's self-efficacy was enhanced through exposure to inquiry instruction. The study of Dangana (2017) is similar to the present study in terms of self-efficacy and research design (quasi-experimental), but differs in the area of Personalized-Learning Strategy, sample size, population, number of research questions and null hypothesis and independent variables.

The study sampled 90 Biology students, while the present study had a sample size of 143 Chemistry students. The study used two instruments; Nature of Science Understanding Test (NOSUT) and Nature of Science Self-efficacy Questionnaire (NOSSEQ) were used for data collection. The data obtained was used in analyzing the research question and the hypotheses stated was subjected to test using t-test statistics at $p \leq 0.05$ levels of significance, while Pearson Product Moment Correlation Coefficient (PPMC) was used in determining the relationship between the groups, while the present study employed two instruments; Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ)for data collection. Data collected were analyzed using independent sample t-test statistic. The study reviewed was conducted among NCE Biology students of colleges of education in Lafiagi, Kwara State, while the present study was conducted among secondary school chemistry students in Zaria Education Zone, Kaduna state. It is worthy of note that this study filled the gap of Personalized-Learning Strategy, performance, subject area and location.

Patrick (2018) examined the relationship between teachers' self-efficacy application package and classroom practices in senior secondary schools in Zaria Education Zone, Kaduna State. Survey research design was employed. The population of the study consists of 293 male and 203 female(494) senior secondary school teachers' in Zaria Education Zone. A sample size of 214 teachers was randomly sampled using Krejcie and Morgan sampling procedure. Questionnaire on teachers' self-efficacy application packages and classroom practices was used for data collection. Questionnaire was administered and data collected thereafter were analyzed using descriptive statistics of frequency and simple percentage for analyzing demographic data, while mean and standard deviation were used to answer the research questions. Hypotheses were tested using Spearman rank-order. The findings revealed that there is a positive relationship between teachers' computer application package self-efficacy in Microsoft Word, Microsoft Excel, PowerPoint, and Internet in classroom practices. Moreover, the research found that those teachers with high levels of self-efficacy application package do not necessarily use it. Therefore, there is a positive relationship between teachers' self-efficacy application package on the three variables and classroom practices.

The study of Patrick (2018) is similar to the present study in the area of self-efficacy but differs in Personalized-Learning Strategy, sample size, population and research design. The study had a sample size of 214, while the present study used a sample size of 143. The study employed Survey design while the present study employed Quasi-experimental design. The study used two instruments; Questionnaire on Teachers Self-Efficacy Application Package and Classroom Practice for data collection. Data collected were analyzed using descriptive statistics of frequency and simple percentage for analyzing demographic data, while mean and standard deviation were used to answer the research questions. Hypotheses were tested using Spearman rank-order, while the present study employed two instruments; Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ)for data collection. Data collected were analyzed using independent sample t-testat $P \leq 0.05$ levels of significance. The study was carried out among secondary teachers, while the present study was carried out among secondary school students. This study filled the gap of Personalized-Learning Strategy, academic performance and location.

Labesa (2018) investigated the Relationship of Emotional-intelligence, Reasoning ability, and Self-efficacy as Predictors of Achievement of Senior Secondary School Chemistry Students in Zonkwa Education Zone, Kaduna State,Nigeria. The study employed correlational survey research design. The population comprised of a total of 450 students. The participant in the study were 152 (89 males, 63 females) secondary school students from Zonkwa Education Zone, Kaduna State, Nigeria. Random sampling was used to select the schools, while intact classes were used. The instruments used for the study were the Trait Emotional-Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT) and Chemistry Self-Efficacy Instrument (CSI) while the student (MOCK) examination result was used as chemistry achievement scores. The responses of the students to the instruments were scored and analyzed using descriptive statistics of means and standard deviations; the Pearson Product Moment Correlation Coefficient and Analysis of Variance ANOVA were used to test correlation at $p \leq 0.05$. The results showed that there was a significant positive relationship among emotional intelligence, reasoning ability, self-efficacy and academic achievement in chemistry. The results also indicated that there was a significant positive relationship among emotional intelligence, reasoning ability, self-efficacy and academic achievement of SS II male students, SS II female students and their academic achievement in chemistry. The results further indicated no significant differences between SS II male and female mean scores in chemistry, emotional intelligence, reasoning ability and self-efficacy.

The study of Labesa (2018) is similar to the present study in terms of self-efficacy and academic performance but differs in the areas of Personalized-Learning Strategy, Emotional-intelligence, Reasoning ability, sample size, population and research design. The study employed Correlational Survey design while the present study used quasi-experimental research design. The study had a sample size of 152 students, while the present study used a sample size of 143 students. The study employed three instruments; Trait Emotional-Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT) and Chemistry Self-Efficacy Instrument (CSI) and student (MOCK) examination result was used as chemistry achievement scoresfor data collection. The responses of the students to the instruments were scored and analyzed using descriptive statistics of means and standard deviations; the Pearson Product Moment Correlation Coefficient and Analysis of Variance ANOVA, while the present study employed two instruments; Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) for data collection. Data collected were analyzed using independent sample t-test statistic. Furthermore, the study was carried out among Senior Secondary School Chemistry Student in Zonkwa Education Zone, Kaduna State, Nigeria, while the present study was carried out among Senior Secondary School Chemistry Student in Zaria Education Zone. This study filled the gap of Personalized-Learningand location.

Akala (2010) investigated gender differences in students' achievement in chemistry in Secondary Schools of Kakamega District, Kenya. The study adopted a cross-sectional descriptive survey employing correlational methods to investigate gender differences in chemistry achievement levels of girls and boys. The study comprised twelve (12) stratified selected public secondary schools in Kakamega district. A total of 386 students responded to a five-item, chemistry Achievement Test (CHAT) comprising descriptive, mathematical and spatial ability items. The students also responded to the Attitude Sale (AS). The teachers filled the Chemistry Teachers' Questionnaire (CTQ) on the reasons for poor performance of students in Chemistry and their possible solutions. A reliability coefficient of 0.8 was established using Pearson Product Moment Correlation Coefficient (PPMCC). Quantitative data obtained from the CHAT were analyzed using Statistical Package for Social Sciences (SPSS). The statistics derived included percentages, mean, Pearson r, standard deviation, students' t–test and Analysis of variance (ANOVA). PPMCC was used to determine the relationship between attitude and chemistry achievement. The study revealed that gender was strongly associated with Chemistry achievement ($r= 0.9880$, $\alpha > 0.001$). As a result, boys' schools performed better than girls' schools. Boys had a stronger affinity and interest towards Chemistry. Teacher and school factors were of little effect on Chemistry achievement with respect to gender.

The study of Akala (2010) is similar to the present study in that both studies were carried out in chemistry. Both studies considered gender as a variable, they both used PPMCC, mean and standard deviation, but differs in the design, population, sample size, instruments, self-efficacy, Personalized-Learning, statistical tools and location. The study of Akala (2010) had a population of 63, 422 with a sample size of 386 SS 2 chemistry students, while the present study used a population of 6,527 with a sample size of 143 SS 2 chemistry students. The study reviewed used three instruments for data collection: Chemistry Achievement Test (CHAT), Attitude Sale (AS) and Chemistry Teachers' Questionnaire (CTQ) while the present study used two instruments; MCPT and SEQ for data collection. Data collected were analyzed using students' sample t–test and ANOVA while the data collected in the present study were analyzed using Mann-Whitney

U-test and independent samples t-test. The study was carried out among secondary schools of Kakamega District, Kenya while the present study was carried out among senior secondary school chemistry students in Zaria Education zone, Kaduna State, Nigeria. Therefore, this study filled the gap of Personalized-Learning Strategy, self-efficacy and location.

Tenaw (2013) investigated the relationship between Self-efficacy, Academic Achievement and Gender in Analytical Chemistry I (ACI) at Debre Marykos College of Teacher Education (DMCTE) in Ethiopia. The study used correlational research design. The study comprised of a total population of 200 students, out of which 80 students were sampled for the study. The self-efficacy survey and the ACI achievement test were completed by 80 students. The self-efficacy survey data were gathered by likert scale questionnaire. By using inferential statistic (independent sample t-test at $P \leq 0.05$ levels of significance), differences of self-efficacy and achievement in gender was calculated using Pearson Product-Moment Correlation (PPMr), the relationships between self-efficacy and achievement were investigated. The analysis of the data indicated that students' level of self-efficacy is medium and there is no significant difference in their self-efficacy between sexes but there is a statistically significant difference in achievement between sexes and also a significant relationship exists between self-efficacy and achievement. The study of Tenaw (2013) is similar to the present study in terms of gender and self-efficacy but differs in the area of Personalized-Learning Strategy, population, sample size, research design and instruments. The study used correlational research design, while the present study used quasi -experimental research design. The study employed the instruments self-efficacy questionnaire and achievement test for data collection, data collected were analyzed using independent sample t-test statistic and Pearson Product Moment Correlation coefficient, while the present study used Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) as instruments for data collection. The data collected were analyzed using independent sample t-test statistic. This study filled the gap of Personalized-Learning Strategy, location and academic performance.

Agba (2014) conducted a study on the Influence of Cognitive Style on Gender and school location on problem solving skills in ecological concept among senior secondary school biology students in Ogoja Education zone, Cross River State. The study used ex-post-facto research design. The sample size used was 452 SS2 Biology students (235 males and 217 females). Five research questions and five null hypotheses guided the study. Two instruments were used for data collection; Group Embedded Test (GET) and Test of Problem-solving in Biology (TPSB). Data collected were analyzed using independent sample t-test at $P \leq 0.05$ levels of significanceand Analysis of Variance (ANOVA). The results showed that cognitive styles of the students significantly influence performance in the test of problem-solving in ecology. There was a difference in the mean achievement between male and female students in their performance in test of problem-solving ecology. The study of Agba is similar to the present study in terms of gender, but differs from the present study in terms of Personalized-Learning Strategy, self-efficacy, population and sample size. The study reviewed was ex-post-facto, while the present study used quasi-experimental research design. The two studies are from different cultural background. This study filled the gap of Personalized-Learning Strategy, self-efficacy which were not captured in the study reviewed.

Dania (2014) investigated the effect of gender on students' academic achievement in secondary school social studies in Delta and Edo States, Nigeria. The study adopted a quasi-experimental design (2x2 non-randomized pre-test, post-test control group) comprising six groups made up of four experimental groups and two control groups. Six schools and 180 upper basic 2 students in Delta and Edo states made up of the sample for the study. Six intact classes were randomly selected and assigned to the experimental and control groups. The instrument used in the study was the achievement instrument tagged Social Studied Achievement Test (SSAT). The validity and reliability of these instruments were established. The reliability was established using Pearson Product Moment Correlation coefficient (r);Mean, standard deviation and analysis of covariance (ANCOVA). The result revealed that gender had no significant effect on students' achievement in social studies. Also, the result showed that there was significant integration effect of treatment and gender on students' academic performance in social studies. The study of Dania is similar to the present study in terms of gender, academic performance and research design; the differences are Personalized-Learning Strategy,subject area, self-efficacy, population, sample size, instrument and location. The study employed Social Studies Achievement Test (SSAT) and analysis of covariance (ANCOVA) statistical tool was used for the analysis, while the present employed Mole Concept Performance Test (MCPT) and Self-efficacy Questionnaire (SEQ) as the instruments for data collected. The data collected were analyzed using independent sample t-testat $P \leq 0.05$ levels of significance. The study was carried out in Edo State, Nigeria, while the present study was carried in Kaduna State, Nigeria. This study filled the gap of Personalized-Learning Strategy, self-efficacy and location.

Ajayi and Ogbeba (2017) evaluated the effect of gender on students' achievement in stoichiometry using hands-on activities. The study adopted a quasi-experimental research design. A sample of 292 students from eight purposively selected secondary schools out of a population of 8,381 SS II students from zone C of Benue State, Nigeria was used for the study. Stoichiometry Achievement Test (SAT) was used for data collection. Reliability coefficient of 0.92 was established using Pearson Product Moment Correlation Coefficient (PPMCC). Two research questions and two null hypotheses guided the study. The research questions were answered using mean and standard deviation while the null hypotheses were tested at P≤0.05 levels of significance using Analysis of covariance (ANCOVA). Result revealed that there was no significant difference in the mean achievement scores between male and female students taught stoichiometry using hands-on activities; (F(1, 145) = 4.160, p>0.05). It also found no significant interaction effect between methods and gender on the mean achievement scores of students in stoichiometry; (F, (1, 291) = 0.11, p>0.05). The study of Ajayi and Ogbeba (2017) is similar to the present study in that both studies were carried out in chemistry. Both studies employed quasi experimental design and considered gender as a variable, they both used PPMCC, mean and standard deviation, but differs in self-efficacy, Personalized-Learning, population, sample size, instrument and statistical tools.

The study of Ajayi and Ogbeba (2017) had a population of 8,381 with a sample size of 292 students, while the present study used a population of 6,527 with a sample size of 143 students. The study used Stoichiometry Achievement Test (SAT) for data collection while the present study used two instruments; MCPT and SEQ for data collection. Data collected was analyzed using ANCOVA while the data collected in the present study were analyzed using Mann-Whitney U-test and independent samples t-test at P≤0.05 levels of significance. The study was carried out among SS II students from zone C of Benue State, Makurdi, Nigeria while the present study was carried out among senior secondary school chemistry students in Zaria Education zone, Kaduna State, Nigeria. Therefore, this study filled the gap of Personalized-Learning Strategy, self-efficacy and location.

2.9 Implication of Literature Reviewed for the Present Study

The implication of this study is based on the following literature reviewed:

Akinsola and Awofala (2009) investigated the effect of Personalized Print-based Instruction on Achievement and Self-efficacy regarding Mathematics word problems among senior secondary students in Lagos State, Nigeria.Bautista (2012) examined the effect of Personalized Instruction on academic achievement of students in Physics in General Education Department of Cagayan Valley Computer and Information Technology College, Inc., Santiago City, Isabela, Philippines.Savio-Ramos (2015) investigated the Efficacy of Personalized-Learning in Algebra as a remediation tool among students of Arizona University, United State. Ferhat and Mehmet (2016) examined the effect of Personalized Instruction System on the academic achievement of students of Software Engineering Department of Technology Faculty in Turkey.Swan (2017) examined the effect of Personalized-Learning and its' effectiveness on Understanding and practice in College of Education, Health and Human Development, University of Canterbury, New Zealand.In a recent study conducted by Alalwneh and Alomari (2018), the study examined the Impact of Personalized Teaching Strategy on the Achievement of the students of Vocation in Irbid University college, Irbid.

Based on the available literature reviewed, it is shown that most of the study cited on Personalized-Learning Strategy on self-efficacy and performance is limited. Hence, the researcher filled the gap by adding the following variables: self-efficacy, academic performance, subject area which are mainly Biology, mathematics, physics, vocation and location. Therefore, this study investigated the effect of Personalized-Learning Strategy on self-efficacy and performance in mole concept among secondary school students in Zaria, Kaduna state, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1Introduction

This study aimedat investigating the effects of Personalized-Learning Strategy on self-efficacy and academic performance in Mole Concept among senior secondary school chemistry students in Zaria education zone, Kaduna State, Nigeria. This chapter explains the procedure used in carrying out the study under the following sub-headings:

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Techniques

3.5 Instrumentation

3.5.1 Description of the Instruments

3.5.2 Validity of the Instruments

3.6 Pilot Testing

3.6.1 Reliability of the Instruments

3.6.2 Item Analysis

3.7 Administration of Treatment

3.8 Data Collection Procedure

3.9 Procedure for Data Analysis

3.2Research Design

This study adopted quasi-experimental design involving pretest posttest control group design. The study used two groups; experimental and control groups consisting of both male and female studentsfrom two selected schools as presented in Table 3.2. The study used intact classesof 54 and 89 for the sample schools. The students in the Experimental group (EG) were taught Mole Concept using Personalized-Learning Strategy while those in the Control Group (CG) were taught the concept using the conventional method. Based on the pilot testing, majority of the students finished the Mole Concept Performance Test (MCPT) within 45 minutes and the Self-Efficacy Questionnaire (SEQ) within 20 minutes meaning the time allocated for the instrumentswas enough. Therefore,pretest (0_1) was administered to the experimental and control group for a period of forty-five (45) and twenty (20) minutes respectively before the administration of treatment to determine the students equivalence in terms of academic performance and self-efficacy. After the pretest, the experimental group received treatment using Personalized-Learning Strategy (X_1), while the control group received the conventional treatment (X_0). After six weeks of treatment, both groups were subjected to posttest (0_2) for the same period in order to measure their self-efficacy and performance. Thereafter, the question papers and the answers were collected from each of the students. The design for the study is shown in Figure 3.1.

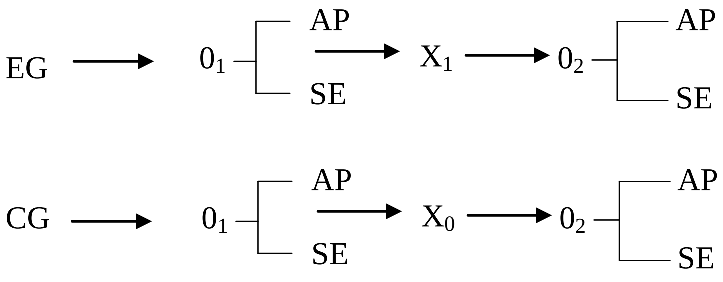

Figure 3.1: Research Design

Key:

EG- Experimental Group

CG- Control Group

0_1- Pretest

0_2- Posttest

X_1- Treatment (Personalized-Learning Strategy)

X_0 - No treatment (Conventional method)

AP- Academic Performance

SE- Self-Efficacy

3.3 Population of the Study

The study area is an urban settlement with diverse group of people, different occupations and ethnic background. The population for this study is heterogeneous comprising all the 35 public senior secondary schools across Zaria education zone in Kaduna state. Among the senior secondary schools,there are 24 co-educational secondary schools, 5 single (boys) and 6 single(girls). For the purpose of this study, the researcherconsidered onlyco-educational senior secondary schools since gender was involved. The population consists of 6,527 SS2 chemistry students out of which 3, 916are male and 2, 611are female students admitted in the year 2018/2019 academic session which formed the population of this study as presented in Appendix H.

3.4 Sample and Sampling Techniques

Four co-educational secondary schools wererandomly selected throughballoting with replacement. The four schools selected from the population were based on location; these are GSS Aminu, GSS Muchia, GSS Chindit and GSS Zaria. A pretest was administered to the participants from the four schools chosen for the purpose of comparability of their academic level. The result obtained from the pretest was subjected to Analysis of variance (ANOVA). The result of ANOVA shows no significant difference between the three schools. Thus, two schools were randomly selected and assigned into experimental and control groups respectively.The schools are;GSS Aminu and GSS Muchia. Each of the two schools selected from the population as the sample for the study has one arm for science class, hence, was used as they are. The sample consists of one hundred and forty-three (143) SS 2 Chemistry students from intact classes of 54 and 89 students respectively. The sample size is in line with Tuckman (1975) and Sambo (2008a), that central limit theorem recommended sample size of minimum of 30 subjects in a variable for experimental study of this nature.

Table 3.1: Sample of the Study

S/N	**Name of School**	**Group**	**Number of Student**		
			Male	**Female**	**Total**
1.	School A	Experimental	20	34	54
2.	School B	Control	45	44	89
Total			**65**	**78**	**143**

3.5Instrumentation

Two instruments were used for the study; Mole Concept Performance Test (MCPT) which was adapted by the researcher from the West African Examination Council(WAEC) past question papers (2015-2018)while the Self-Efficacy Questionnaire (SEQ) was adapted by the researcher to obtain the necessary information that are relevant to the study based on the conceptof mole as contained in the secondary school syllabus and on the concept of self-efficacy.

3.5.1 Description of the Instruments

Two instruments were used for this study which areMole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ).

3.5.1.1 Mole Concept Performance Test (MCPT)

Mole Concept Performance Test (MCPT) wasadapted from WAEC past question papers (2015-2018) by the researcher based on the concept of mole to measure the corresponding conceptual variable of academic performance of the students on Mole Concept. The instrument was administered using the test-retest method. The instrument, MCPTconsists of thirty (30) multiple choice items followed by four (4) options A-D and students were asked to circle the correct option. The instrument was used before and after the treatment. The pretest was used to establish the baseline of students' academic performance score before the commencement of the treatment. The posttest was used to determine the effects of Personalized-Learning Strategy on the academic performance of the students. Mole Concept Performance Test(MCPT) was conducted within 45 minutes for the pretest and the questions and options were reshuffled for posttest after treatment. The specification of the MCPT instrument is shown in Table 3.2.

3.5.1.2 Self-Efficacy Questionnaire (SEQ)

Self-Efficacy Questionnaire(SEQ)wasadaptedfrom Bandura (1977) general self-efficacy scale and Israel (2019) with reliability coefficient of 0.72 and 0.83 respectively. The instrument was administered using the split-half (even-odd) method. The instrument consists of twenty (20) questions and students were asked to tick the most appropriate as it applies to them. The SEQ was conducted within 20 minutes for both pretest and posttest.

The scale is structured using five (5) points Likert scale(SA-Strongly Agree; A-Agree; UD-Undecided; D-Disagree and SD-Strongly Disagreed) inorder to measure the extent to which the respondents agree or disagree with a statement in the scale. Each of the response is scored as thus; SA=5, A=4, UD=3, D=2 and SD=1. The items were selected and fine-tune to suit academic purview. Thus, it was subjected to pilot testing to determine its internal consistency as could be found under reliability of the instrument.

Scoring guide

< 42	Low academic Self-Efficacy
43-66	Moderate Self-Efficacy
≥ 67	High Self-Efficacy

Table 3.2: Item Specification of the Instrument (MCPT) based on Bloom's CognitiveTaxonomy.

Concepts	**Wt. (%)**	**Knw. (20%)**	**Com. (20%)**	**App. (20%)**	**Ana. (14%)**	**Syn. (13%)**	**Eva. (13%)**	**Total (100%)**
Mole	30	**2**(5,6)	**2**(4,17)	**2**(1,2)	**1**(13)	**1**(10)	**1**(3)	9
Avogadro's Number	30	**2**(8,9)	**2**(23,28)	**2**(7,12)	**1**(14)	**1**(24)	**1**(19)	9
Molar Mass	20	**1**(11)	**1**(29)	**1**(15)	**1(**16)	**1**(26)	**1**(20)	6
Chemical equation	20	**1**(25)	**1**(30)	**1**(18)	**1**(21)	**1**(27)	**1**(22)	6
Total	**100**	**6**	**6**	**6**	**4**	**4**	**4**	**30**

Source: Researcher's Field Work (2019).

Key: Knw.=Knowledge, Com.= Comprehension, App.=Application, Ana=Analysis, Syn.=Synthesis, Eva.=Evaluation, Wt.=Weight

3.5.2 Validity of the Instruments

The instruments, MCPT wasadapted by the researcherfrom WAEC and NECO past question papers and SEQ wasalso adapted by the researcher from Bandura (1977) and Israel (2019). The instruments were validated bya lecturer from the Department of Science Education,Ahmadu Bello University, Zaria withPhD in science education, a lecturer from Federal College of Education(F.C. E) Zaria withM.Ed chemistry and a chemistry teacher from Government Commercial College Muchia with B.Ed chemistry with more than five years teaching experience. Before the pilot testing, the validators carried out the following on the instruments:

- Verified if the language used is at the same level with the ability level of the students of the study and free from ambiguity,
- checked whether the time allocated to the instrument is sufficient,
- checked the clarity of the statement and
- checked the content of the test items if it is appropriate to the stated objectives of the study.

Some observations madeby the validatorson theMole Concept Performance Test(MCPT)includes:

i. Question number 9 and 29 were removed because they were perceived to be difficult.

Question 9 read: find the mass of 0.2 mole of P_4 if (P=31) and

Question 29 read: calculate the number of atoms of elements in 18.63g of lead;(Pb=207g).

ii. The test item covered about 80% of the rudiments required in Mole Concept, because the issues of atomicity, stoichiometry, Avogadro’s number, molecules, relative atomic mass and laws of conservation were fairly discussed. Moreover, the questions are standard and are inline with the pupil’s academic ability.

Based on their constructive contributions, face and content validity of the test itemswere effected on the number of items and content to ensure that the instrument is valid for this study. Some of the items perceived to be difficult were removedand the rest were certified. There was no observation made on the instrument Self-Efficacy Questionnaire (SEQ).

3.6 Pilot Testing

The instruments; Mole ConceptPerformance Test (MCPT) was pilot tested using test-retestmethod for the interval of two weeks between the first and second administration as proposed by Tuckman (1975) and Sambo (2008) to determine its internal consistency and its reliability and the Self-Efficacy Questionnaire (SEQ) was pilot tested using split-half (even-odd)method.The test was carried out using twenty (20) SS2 chemistry students.

3.6.1 Reliability of the Instruments

The two instruments were subjected to reliability tests.According to Sambo (2008a) and Pallant (2011), estimated that reliability coefficient values above 0.70 are considered acceptable for an instrument to be used in a research.

3.6.1.1 Reliability of Mole Concept Performance Test (MCPT)

The responses obtained from thetest retest of MCPT from the pilot study was computed using Pearson Product-Moment Correlation Coefficient (PPMC) statistic to test the reliability and internal consistency of the items.The correlation coefficient obtained by the researcher for MCPT was 0.81. The reliability coefficient obtained indicates the level of reliability of the instrument.

3.6.1.2 Reliability of Self-Efficacy Questionnaire (SEQ)

The response obtained from split-half of SEQ in the pilot testing was compared using Cronbach alpha statistic to test the reliability and internal consistency of the items. The reliability coefficient obtained for SEQ wasfound to be 0.89 which indicates that the instrument is reliable for data collection.

3.6.2 Item analysis

The Mole ConceptPerformance Test (MCPT) was analyzed to determine the item difficulty and discrimination indices. Each item is expected to be relevant to the course content. The items should neither be too easy nor too difficult and must discriminate between weak and competent students. The procedure for item analysis is as follows:

3.6.2.1 Facility index (FI) or Difficulty index (DI)

The facility index or difficulty index show the difficulty of each of the items based on the percentage of subjects who got an item correct. The facility index for the instrument (MCPT) was determined using Furst (1958) formula:

$$\mathrm{FI} = \frac{\mathrm{RU} + \mathrm{RL}}{\mathrm{N}} \times 100$$

Where,

FI = Facility Index

RU = Number of upper 27% of those who got the items correctly

RL = Number of lower 27% who got the items correctly

N = Total number of subjects in each of the upper and lower groups (not the total respondents of the test).

Items with facility indices of between the range of 0.30 and 0.80 were recommended and considered by Furst (1958), Usman (2000) and Lakpini (2006) as adequate for selecting good test items for achievement test. In this study therefore, the items with facility indices in the range of 0.30 to 0.80 was adopted for the study based on the recommendation of Usman (2000) and Lakpini (2006).

3.6.2.2 Discrimination Index (DI)

The discrimination index for each of the items was computed by subtracting the number of students in the lower group who score the item correctly from the number in the upper group who got the item correctly. The number was divided by half the number of the students as presented below:

$$\mathrm{DI} = \frac{\mathrm{RU} + \mathrm{RL}}{{}^{1}/_{2}\,\mathrm{N}} \times 100$$

DI = Discrimination Index

RU = Number among upper 27% who score the item right

RL = Number among the lower 27% of subjects who score the items correctly

½ N = Number of subjects in each of the upper and lower groups

According to Furst (1958), Sambo (2008b) and Usman (2008), items in a test with discrimination indices of 0.30 to 0.49 were considered moderately positive while those with 0.70 were considered highly positive. Discrimination index between the range of 0.30 to 0.70 was used in selecting the final items of the MCPT based on Sambo (2008b) and Usman (2008) recommendation.

3.6.2.3 Distractor Analysis

Analysis of distractor is another important part of item analysis. The distractors are important components of an item, as they show a relationship between the total test score and the distractor chosen by the student. Student's performance according to Dufresne, Leonard and Gerace (2012) depends upon how the distractors are designed. Distractor efficiency is one such tool that tells whether the item was well constructed or failed to perform its purpose. Tarrant, Ware and Mohammed (2009) noted that any distractor that has been selected by less than 5% of the students is considered to be a non-functioning distractor (NF-D). Ideally, low-scoring students, who have not mastered the subject, should choose the distractors more often, whereas, high scorers should discard them more frequently while choosing the correct option. By analyzing the distractors, it becomes easier to identify their errors, so that they may be revised, replaced, or removed (Gronlund & Linn, 1990).

3.7Administration of Treatment

The studyinvolved teaching Mole Concept using Personalized-Learning Strategy(PLS) and conventional method. Two different Lesson guides (PLS and Conventional method lesson plans) addressing the same instructional objectives and content of Mole Concept was used for experimental and control groups respectively.

3.7.1 Personalized-Learning Strategy (PLS)

Before the commencement of treatment, a pretest was administered to the experimental group to establish their academic performance and self-efficacy levels. The lesson plan for experimental group was based on PLS that provides opportunities for a particular student to learn at their pace with the guidance of the instructor.The teacher introduces the lesson by asking questions from the previous class lesson for 10 minutes and thereafter gives each students the printed materials based on the lesson for the day. The students were given 30 minutes for their students' activities based on PLS where they were required to write down the lesson derived on the student worksheet based on their understanding from the materials while 40 minutes was used for individual student discussion in the gathering of their colleagues and teacher. The teacher uses 40 minutes for more explanation on the students' discussed activities, evaluation and conclusion. At the end of six weeks of treatment,posttest was administered to determine the self-efficacy level and academic performance of the students.

3.7.2 Personalized-Learning Strategy Procedure

The study adopted Clarke (2003) Personalized-Learning Strategy procedure (presented in figure 3.2) as follows:

1)Personal Learning Plans: Students and their guardian regularly assess student strengths, interests, and recent achievements so they can plan for further learning activities that challenge students to achieve more.

2)Portfolios: Students collect evidence of their learning from classes that show they are moving toward achieving their goals and meeting their expectations.

3) Student Presentations (or Exhibitions): Students explain the meaning of their work to a gathering of their friends, teachers, and guidance - receiving feedback on their progress and ideas for new investigations.

4) Assessment: From the presentation of the students, the teacher makes necessary correction and assesses the students based on the content of the lesson.

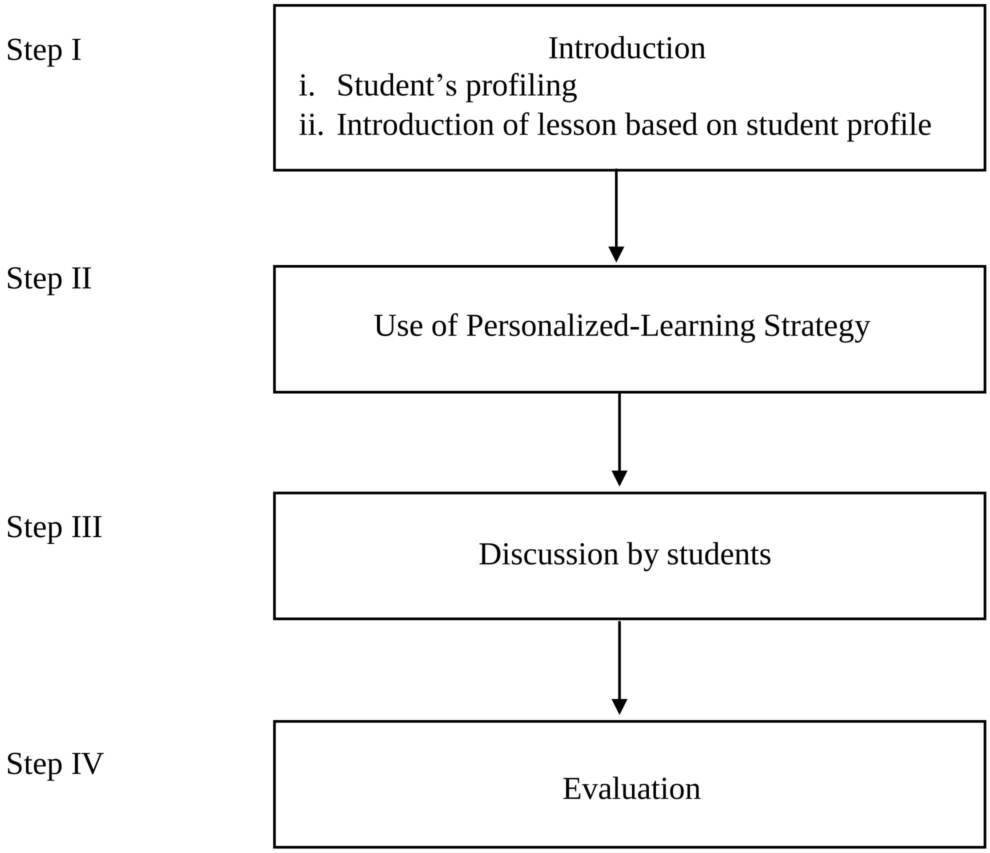

Figure 3.2: Flow chart of Personalized-Learning Strategy

Source: Clarke (2003)

3.7.3 Control Group

Before the commencement of lesson, a pretest was administered to the students. The control group was taught Mole Conceptusing the conventional method lesson plan for six weeks.At the end of six weeks, posttest was administered to determine the students' self-efficacy and academic performance.

3.8Data Collection Procedure

The researcher administered two instruments, MCPT and SEQfor a period of 45 and 20 minutes respectively as pretest to both the experimental and control groups to test their academic performance and self-efficacy level before treatment. The pretest scores of the subjects were obtained prior to the administration of treatment to serve as data for determining the equivalence of the experimental and control groups.

Posttest was administered after the treatment for the same period. The posttest scores obtained after the treatment administration served as data to measure students' academic performance and self-efficacy. The MCPT and SEQ were retrieved immediately on completion by the respondents while scores were then collated based on stated research questions and hypotheses formulated.

3.9Procedure for Data Analysis

The researcher used a number of statistical tools like descriptive statistics using mean, standard Deviation, mean rank, sum of mean rank and mean rank difference were used to answer the research questions, Mann Whitney U-test to test null hypotheses one and three and independent sample t-test to test null hypotheses two and four at $P \leq 0.05$ levels of significance.

The null hypotheses (HO) tested were:

H01: There is no significant difference between self-efficacy level of chemistry students taughtMole Concept using Personalized-Learning Strategy and those taught the same concept using the conventional method.

H01: was tested using Mann-Whitney U-test.

H02: There is no significant difference between the mean performance scores of chemistry students taught Mole Concept using Personalized-Learning Strategy and those taught the concept using conventional method.

H02: was tested usingindependent sample t-test statistic.

H03: There is no significant difference between self-efficacy level of male and female students taught Mole Concept using Personalized-Learning Strategy.

H03: was tested using Mann Whitney U-test.

H04: There is no significant difference between mean performance scores of male and female students taught Mole Concept using Personalized-Learning Strategy.

H04: was tested using independent sample t-test statistic.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter dealt with data analysis, presentation and discussion. The study investigated the effect of Personalized-Learning Strategy on Secondary School Students' Self-Efficacy and Performance in Mole Concept, Zaria Education Zone, Nigeria. Descriptive and inferential statistical tools were used to analyze the data collected. Testing of null hypotheses was carried out in the course of data presentation to enable the researcher draw some conclusions and make recommendations. The procedure is presented under the following headings:

4.2 Data Analysis

4.2.1 Research Questions Analysis

4.2.2 Null Hypotheses Testing

4.3 Summary of Findings

4.4 Discussions

4.2 Data Analysis

The data collected from the study using the instruments:Mole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ) were analyzed using descriptive statistics of means, standard deviations, mean rank and sum of mean rank to answer the research questions whileinferential statistics like Mann-Whitney U-test and independent samplest-test were used to test the null hypotheses at $p \leq 0.05$ levels of significance.

4.2.1 Research Questions Analysis

Research Question One: What is the mean difference between the self-efficacy level of chemistry students taught Mole Conceptusing Personalized-Learning Strategy and those taught the same concept using conventional method?

To answer research question one, post-test scores of experimental and control groups generated from SEQ were subjected to descriptive statistic to calculate mean rankand mean rank difference. Summary of the analysis is presented in Table 4.1

Table 4.1: Post-test Self-Efficacy Scores of Experimental and Control Groups

Groups	*N*	Mean Rank	Sum of Ranks	Mean Rank Difference
Experimental	54	106.05	5726.50	54.71
Control	89	51.34	4569.50	
Total	143			

The resultin Table 4.1 shows that experimental group had a higher mean rank scoreof 106.05compared to that of the control group who had 51.34 as mean rank score with mean rank difference of 54.71. Thisdifference is in favour of experimental group who were taught Mole Conceptusing Personalized-Learning Strategy. This means that Personalized-Learning Strategy enhanced students' Self-Efficacy in Mole Concept. To find out how significant the difference is,Mann-Whitney U-test was used in analyzing the scores.

Research Question two: What is the difference between the mean performance scores of chemistry students taughtMole Concept using Personalized-Learning Strategyand those taught with conventional method?

To answer research question two, post-test scores of experimental and control groups generated from MCPT were subjected to descriptive statistic to calculate mean and standard deviation. Summary of the analysis is presented in Table 4.2

Table 4.2: Mean Performance Scores of Experimental and Control Groups

Group	***N***	$\bar{X}$	***SD***	***MD***
Experimental	54	25.11	3.69	8.30
Control	89	16.81	22.78	
Total	143			

The results in Table 4.2 shows that there is a difference between the performance of students exposed to Personalized-Learning Strategy and those exposed to conventional methods. Their computed mean scores were 25.11 and 16.81 for the experimental and control groups respectively with a mean difference of 8.30 in favour of the experimental group. To find out how significant the difference is, the data were subjected to independent sample t-test statistic.

Research Question three: What is the mean difference between the self-efficacy level of male and female students taught Mole Concept using Personalized-Learning Strategy?

To answer research question three, post-test scores of male and female students in the experimental group generated from SEQ were subjected to descriptive statistic to calculate mean rankand mean rank difference. Summary of the analysis is presented in Table 4.3.

Table 4.3: Post-test Self-Efficacy Scores of Male and Female Students in the Experimental Group

Groups	***N***	**Mean Rank**	**Sum of Ranks**	**Mean Rank Difference**
Female	34	28.41	966.00	2.46
Female	20	25.95	519.00	
Total	54			

The result in Table 4.3reveals that difference exist in the self-efficacy level shown by female and male students when exposed to Personalized-Learning Strategy. Their mean rankscores were 28.41 and 25.95 respectively for the female and male student in the experimental groupwith mean rank difference of 2.46 in favour of the female students. To find out how significant the difference is, the scores were subjected to Mann-Whitney U-test.

Research Question four: What is the difference between the mean performance scores between male and female students taught Mole Concept using Personalized-Learning Strategy?

To answer research question four, post-test scores of male and female students in experimental group generated from MCPT were subjected to descriptive statistic to calculate mean and standard deviation. Summary of the analysis is presented in Table 4.4.

Table 4.4: Post-test Mean Performance Scores of Male and Female StudentsinExperimental Group

Group	*N*	$\bar{X}$	*SD*	*MD*
Female	34	25.71	3.64	1.61
Male	20	24.10	3.66	
Total	54			

The result in Table 4.4 shows that the female students had a mean score of 25.71 and their male counterpart had a mean score of 24.10 with a mean difference of 1.61 in favour of the female students. Their respective standard deviation scores were found to be 3.64 and 3.66. To ascertain if the difference in the mean scores between female and male students is statistically significant, the corresponding null hypothesis was tested using independent sample t-test at $P \leq 0.05$ levels of significance.

4.2.2 Null Hypotheses Testing

Null Hypothesis One: There is no significant difference betweenthe self-efficacy level of chemistry students taught Mole Concept using Personalized-Learning Strategyand those taught using conventional method.

To test null hypothesis one, post-test mean rank scores obtained from the Self-Efficacy Questionnaire (Table 4.1) of the experimental and control groups were subjected toMann-Whitney U-test at $P \leq 0.05$ levels. Summary of the analysis is presented in Table 4.5.

Table 4.5: Mann-Whitney U-test Analysis of Students' Self-Efficacy in the Experimental and Control Groups

Groups	***N***	**Mean Rank**	**Sum of Ranks**	***U***	***P***	**Remark**
Experimental	54	106.05	5726.50	564.50	0.001	S
Control	89	51.34	4569.50			
Total	**143**					

Significant at $P < 0.05$ level

The result in Table 4.5 reveals that there is a significant difference in the self-efficacy level meanrank scores between experimental and control groups in favour of the experimental group. The experimental and control groups recorded meanrank scores of 106.05 and 51.34 respectively. The p-value is 0.001 which is less than $P \leq 0.05$ level of significance at 141 degree of freedom. Therefore, the null hypothesis one which states that there is no significant difference between the self-efficacy level of chemistry studentsexposed to Personalized-Learning Strategyand those exposed to conventional method is hereby rejected. Thus, Personalized-Learning Strategywas found to be effective in improving students' self-efficacy in Mole Concept than the conventional method

Null Hypothesis two: There is no significant difference between the mean performance scores of chemistry students taught Mole Concept using Personalized-Learning Strategy and those taught the concept using conventional method.

To test null hypothesis two, post-test scores obtained from the Mole Concept Performance Test (Table 4.2) of the experimental and control groups were subjected to independent sample t-test statistic at P≤ 0.05 levels of significance. Summary of the analysis is presented in Table 4.6.

Table 4.6: Independent sample t-test for Performance between Experimental and Control Groups

Group	***N***	$\bar{X}$	***SD***	***T***	***Df***	***P***	**Remark**
Experimental	54	25.11	3.69	2.65	141	0.009	S
Control	89	16.80	22.78				
Total	**143**						

Significant at $p < 0.05$ level

The resultin Table 4.6 reveals that there is a significant difference in the mean performance scores of experimental and control groups in favour of the experimental group. The experimental and control groups recorded a mean score of 25.11 and 16.81 respectively. The p-value is 0.009 which is less than 0.05 level of significance at 141 degree of freedom. Therefore, the null hypothesis which says that there is no significant difference between the mean performance scores of chemistry students taught Mole Concept using Personalized-Learning Strategy and those taught using conventional method is hereby rejected. This implies that the treatment with Personalized-Learning Strategy significantly enhanced the performance of the students in the experimental group compared to their courter-part in the control group. Thus, Personalized-Learning Strategy was found to be effective in improving students' academic performance in Mole Concept.

Null Hypothesis three: There is no significant difference between the self-efficacy level of male and female students taught Mole Concept using Personalized-Learning Strategy.

To test null hypothesis three, post-test scores obtained from the Self-Efficacy Questionnaire (Table 4.3) of male and female students in experimental group were subjected to Mann-Whitney U-test at P≤ 0.05 level of significance. Summary of the analysis is presented in Table 4.7.

Table 4.7: Mann-Whitney U-test Analysis of Male and Female Students Self-Efficacy in the Experimental Group

Groups	***N***	**Mean Rank**	**Sum of Ranks**	***U***	***P***	**Remark**
Female	34	28.41	966.00	309.00	0.578	NS
Male	20	25.95	519.00			
Total	**54**					

Not significant at p > 0.05 level

The result in Table 4.7 revealsthat female and male students recorded mean rank scores of 28.41 and 25.95 respectively. The p-value is 0.578 which is greater than P>0.05 levels of significance at 52 degree of freedom. This implies that there is no significant difference in self-efficacy level of male and female chemistry students. This indicates that male and female students had similar level of self-efficacy when exposed to Personalized-Learning Strategy. Based on the result shown in Table 4.7, the null hypothesis which states that there is no significant difference between the self-efficacy level of male and female students taught Mole Concept using Personalized-Learning Strategy is hereby retained.By implication, male and female student'sself-efficacy level was relatively the same when exposed to Personalized-Learning Strategy.

Null Hypothesis four: There is no significant differencebetween the mean performance scores of male and female students taught Mole Concept using Personalized-Learning Strategy.

To test null hypothesis four, post-test scores obtained from the Mole Concept Performance Test (Table 4.4) of male and female students in the experimental group were subjected to independent sample t-test statisticat P≤ 0.05 level of significance. Summary of the analysis is presented in Table 4.8.

Table 4.8: Independent sample t-test of Male and Female Students in Experimental Group

Group	***N***	$\bar{X}$	***SD***	***T***	***Df***	***P***	**Remark**
Female	34	25.71	3.64	1.56	52	0.12	NS
Male	20	24.10	3.66				
Total	54						

Not significant at p > 0.05 level

The resultin Table 4.8 reveals that there is no significant difference in the mean performance scores between male and female students in the experimental group. The female and male students recorded a mean score of25.71 and 24.10 respectively. The p-value is 0.12 which is greater than P≤0.05 level of significance at 52 degree of freedom. Therefore, the null hypothesis which states that there is no significant difference in the mean performance scores between male and female students taught Mole Concept using Personalized-Learning Strategy is hereby retained. Thus, Personalized-Learning Strategy is found to be effective in improving students' performance regardless of their gender.

4.3 Summary of Major Findings

The major findings of the study are presented as follows:

1. Comparing self-efficacy level of students taught Mole Concept using Personalized-Learning Strategy and those taught using conventional method, significant differences exist in favour of experimental group.
2. The mean academic performance scores of chemistry students taught Mole Concept using Personalized-Learning Strategy and those taught the concept using conventional method indicates a significant difference which is in favour of the experimental group.
3. The self-efficacy level between male and female students taught Mole Concept using Personalized-Learning Strategy shows no significant difference.
4. The mean academic performance scores of male and female students taught Mole Concept using Personalized-Learning Strategyshows no significant difference. This implies that gender (sex) does not determine the performance of students when they are exposed to Personalized-Learning Strategy.

4.4 Discussion of Results

This research work investigated the effects of Personalized-Learning Strategy on self-efficacy and academic performance in Mole Concept among senior secondary school chemistry students in Zaria Education Zone, Kaduna State, Nigeria. Four null hypotheses were formulated and tested based on the scores of the subjects obtained from Mole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ). Analysis of the data obtained are presented in Table 4.1 to 4.8 in accordance with the stated null hypotheses. The findings are discussed as follows:

From Table 4.5, and the data relating to research question one, the result of the findings showed that there was significant difference in the self-efficacy level when students were exposed toPersonalized-Learning Strategy and the conventional method in favour of experimental group and this could be as a result of the use of Personalized-Learning Strategy to teach the experimental group. This agreed with Jacobson (2010) and Yazachew (2013) who stated that due to the student-centered nature of the Personalized-Learning Strategy, students' self-efficacy is promoted because the strategy stimulates cognitive activities. The study also agreed with Lames (2014) who found out that Personalized-Learning Strategy increasedstudent's self-efficacy. The study also agreed with that of Bichi, (2002) who observed that as students engage in activities; they acquire skills and confidence which aid their capacity to tackle future problems.

The result in Table 4.6 showed that there is a significant difference between the students exposed to Personalized-Learning Strategy and those taught using the conventional method. It was observed that performances of students who were taught Mole Concept using Personalized-Learning Strategy outperformed others taught using the conventional method. This implies that the use of Personalized-Learning Strategy improved students' academic performance in Mole Concept. The higher academic performance recorded by students taught using PLS may be due tohigher level of understanding acquired through active participation in the learning process. This finding is in line with that of Akinsola (2009), Bautista (2012), Savio-Ramos (2015) who found out that the Personalized-Learning Strategy was effective in enhancing students' performance. They found a significance difference in performance in favour of the experimental group. This is evidenced in the higher mean scores obtained by students in the experimental groups of their respective studies when compared to other conventional method of learning. Also, Ferhat and Mehmet (2016) and Swan (2017) in a separate study found that Personalized-

Learning Strategy is effective in the teaching and learning process. They recommended the use of Personalized-Learning Strategy in the teaching and learning among secondary school students. The relatively poor performance of the subjects in the control group is an indication that the conventional method adopted in teaching science by science teachers is not effective in promoting cognitive processes in students in senior secondary school as observed by Usman (2001).

Table 4.7 revealed no significant difference between the self-efficacy level of male and female students in the experimental group. This could be due to the fact that Personalized-Learning Strategy is gender friendly. This implies that Personalized-Learning Strategyincreased male and female students' self-efficacy level towards the learning of Mole Concept. The study is in agreement with Akinsola (2009), Lames (2014) and Mohammed (2016), who found no significant difference in the self-efficacy level of male and female students using Personalized-Learning Strategy. But this study disagreed with Dangana (2017) who found significant difference on students' self-efficacy in favour of the female students. Therefore, with these evidences Personalized-Learning Strategyis gender friendly.

Table 4.8 showed that there is no significant difference between the mean academic performance of male and female student when exposed to Personalized-Learning Strategy. This implies that Personalized-Learning Strategy is gender friendly. This finding is in agreement with that of Bautista (2012), Savio-Ramos (2015), Ferhat and Mehmet (2016), Swan (2017) and Alalwneh (2018) who reported that there was no significant gender difference in performance when students were exposed to Personalized-Learning Strategy. Therefore, with these evidences Personalized-Learning Strategyis gender friendly.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study determined the effects of Personalized-Learning Strategy on Secondary School Students' Self-Efficacy and Performance in Mole Concept, Zaria Education Zone, Nigeria. The objectives of the study were to assess the self-efficacy and performance of students in Mole Concept when exposed to the Personalized-Learning Strategy. This chapter is summarized under the following sub-headings:

5.2 Summary

5.3 Major Findings

5.4 Conclusions

5.5 Recommendations

5.6 Suggestion for further Studies

5.7 Contributions to Knowledge

5.8 Limitation of the Study

5.2 Summary

This study investigated the effects of Personalized-Learning Strategy on self-Efficacy and Academic Performance in Mole Concept among Senior Secondary School Chemistry Students in Zaria Education Zone, Kaduna State, Nigeria. This study was presented in five chapters. Chapter one presents the problem of this study which was prompted by low level self-efficacy and poor academic performance of secondary school Chemistry students. The study was guided by four objectives, four research questions and four null hypotheses corresponding to the statedobjectives. Other aspects of the chapter are significance of the study, scope of the study and basic assumptions. The study was limited to only SSS II students of public secondary schools offering Chemistry in Zaria Education Zone, Kaduna State, Nigeria.In chapter two, attempt was made to review available literatures on self-efficacy, academic performance, teaching methods and gender; and their effects on student's self-efficacy and performance in Mole Concept.

Chapter three adopted quasi experimental design involving pretest-posttest control group design. The population of this study comprised all the 35 public senior secondary schools in Zaria Education zone. Out of these schools, there are 24 co-educational, 5 single male and 6 single female secondary schools with a total population of 6,527 SS2 chemistry students involving 3,916 males and 2,611 females.For the purpose of this study, only co-educational secondary schools were used since gender is one of the variables. Simple random sampling technique by balloting was used to select two schools for the study with intact classes of 54 and 89 students respectively making a total sample size of one hundred and forty-three (143) SS 2 Chemistry students. The two sampled schools were; Government Secondary School Aminu and Government Secondary School Muchia for experimental and control groups respectively.

The experimental group was exposed to Personalized-Learning Strategy while the control group was exposed to the conventional method for a period of six (6) weeks. The instruments used for this study were Mole Concept Performance Test (MCPT) and Self-Efficacy Questionnaire (SEQ). The two instruments were used to collate data as pretest and posttest which were also used in answering the research questions and to test the stated null hypotheses. The MCPT was a 30 items multiple choice and short answered test items consisting of all six levels of cognitive taxonomy. The reliability coefficient of MCPT and SEQ were found to be 0.81 and 0.89

respectively. MCPT and SEQ were used to collect relevant data which were analyzed usingdescriptive statistics like mean, standard deviation, mean rank and sum of mean rank to answer the research questions while inferential statistics like Mann-Whitney U-test and independent samples t-testat $P \leq 0.05$ levels of significancefor retaining or rejecting the stated null hypotheses.

In chapter four, SPSS package version 20 was used to analyze the data obtained and result of data analysis was presented. The result revealed that there is a significant ($P \leq 0.05$) difference in the self-efficacy level mean rank scores between experimental and control groups in favour of the experimental group. There was also a significant ($P \leq 0.05$) difference in the mean performance scores of experimental and control groups in favour of the experimental group. No significant ($P \geq 0.05$) difference exists in self-efficacy level and academic performance of male and female chemistry students in the experimental group.

5.3 Major Findings

The following findings were obtained:

1. Significant differenceexistsbetween the self-efficacy levels of students taught Mole Concept using Personalized-Learning Strategyand those taught using the conventional method. The observed difference is in favour of experimental group.
2. The analysis of the posttest mean academic performancescores indicates that there is a significant difference between students exposed to Personalized-Learning Strategy compared to those taught with the conventional method, the observed difference is in favour of the experimental group.

3. No significant difference was observed between the self-efficacy levelsof male and female students taught Mole Concept using Personalized-Learning Strategy.
4. No significant difference was observedbetween the meanacademic performance scores of male and female students taught Mole Concept using Personalized-Learning Strategy. This indicates that Personalized-Learning Strategy is gender friendly.

5.4 Conclusions

Based on the findings of this study, the following conclusions were made:

1. The use of Personalized-Learning Strategyimproved the self-efficacy levelsofsecondary school chemistry students in Mole Concept.
2. The performance of secondary school chemistry students in Mole Concept was enhanced through the use of Personalized-Learning Strategy.
3. Self-efficacy levels of male and female secondary school chemistry students were not different when taught Mole Concept using Personalized-Learning Strategy
4. Academic performance of male and female secondary school chemistry students was not different whentaught Mole Concept using Personalized-Learning Strategy.

5.5 Recommendations

Based on the findings of this study, the following recommendations are made:

1. Teachers of chemistry and other science-based subjects should use Personalized-Learning Strategyfor improving students’ self-efficacy and academic performance.
2. Personalized-Learning Strategy should be use in teaching male and female chemistry students and other science-related courses for improved self-efficacy and academic performance due to its gender friendly nature.

3. Government agencies and stakeholders should organize training and retraining on regular courses, workshops, seminars and in-house training for chemistry teachers on the use of Personalized-Learning Strategy for maximum students' self-efficacy levels and academic performance.

5.6Suggestions for further Study

The following are the suggestions for further studies:

1. A similar study can be carried out in senior secondary schools and institutions in other parts of the country. Such studies may include undergraduate, polytechnics and colleges of education students to see if a similar result would be obtained.
2. The study can be replicated to include attitude, interest, motivation and general attitude of students towards the use of Personalized-Learning Strategy.

5.7Contributions to Knowledge

The following contributions to knowledge were made from the results and findings of this study:

1. The study established that Personalized-Learning Strategy enhanced self-efficacy and academic performance of secondary school chemistry students in Mole Concept.
2. The findings in this study revealed that the use of Personalized-Learning Strategy is efficient in eliminating gender related differences in teaching of chemistry, indicating that the strategy is gender friendly.
3. The findings of this studyhave provided new information to the existing literature on the use of Personalized-Learning Strategyand in Mole Concept.

4. The instruments adapted by the researcher (MCPT and SEQ) and the lesson plan developed for this study can be used by other researchers carrying out their studies in similar area and also classroom teachers.

5.8 Limitation of the Study

This study has the following limitations:

1. The restriction of the study to only two senior secondary schools in Zaria Education Zone, Kaduna State, Nigeria made the scope of the generalizations that can be made from the study fairly narrow.
2. Literatures reviewed on Personalized-Learning Strategy is limited that is why the researcher used some studies that are similar.

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APPENDICES

Appendix A: Mole Concept Performance Test (MCPT)

DEPARTMENT OF SCIENCE EDUCATION

FACULTY OF EDUCATION

AHMADU BELLO UNIVERSITY, ZARIA

Mole Concept Performance Test (MCPT)

Dear Respondent,

I am an M. Ed student of the above institution running a research study on the "**Effect of Personalized-Learning Strategy on Secondary School Students' Self-Efficacy and Performance in Mole Concept, Zaria Education Zone, Nigeria".**

All information given will be treated with utmost confidentiality; and responses will be used for research purpose only.

Instruction: Answer all Questions by circling the correct option

Section A: Demographic Information

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

Age: …………..... Gender: …………………… Time: 45 Minutes

Section B: Mole Concept

1. A piece of Cu contains 6.022×10^{24} atoms. How many moles of Cu atoms does it contain?
   (a) 10 moles
   (b) 12.3 moles
   (c) 0.8 moles
   (d) 0.1 moles
2. What will be the mass of 5mole of SO_2 if Molecular mass of SO_2 = 64g
   (a) 320g
   (b) 16g

(c) 12.8g

(d) 6.022g

3. A sample of He gas occupies 5.6 litres volume at 1 atm and 273K. How many mole of He are present in the sample?

   (a) 5.30 moles

   (b) 5.60 moles

   (c) 0.25 moles

   (d) 48.75 moles.

4. State the law of conservation of mass.

   (a) Nothing can be created or destroyed

   (b) Mass is indestructible

   (c) Mass of an atom is constant

   (d) In any physical or chemical change, mass can neither be created nor be destroyed.

5. How many moles of $H_2$are involved in the reaction $NH_{3(g)} \rightarrow N_{2(g)} + H_{2(g)}$

   (a) 4 moles

   (b) 3 moles

   (c) 2 moles

   (d) 5 moles

6. How many grams of Chlorine are needed to have 5.0 moles of Chlorine?

   (a) 7.17g

   (b) 17.75g

   (c) 40.50g

   (d) 177.5g

7. How many moles of phosphorus are present in 114.95 g of phosphorus?

   (a) 2.72 moles

   (b) 3.71 moles

   (c) 7.42 moles

   (d) 1.73 moles

8. There are 6.02×10^{23} atoms in one ____ of atoms.

   (a) Mole

   (b) Newton

(c) amu

(d) Kilogram

9. The mass in grams of one mole of any pure substance is called its ____ mass.

(a) atomic

(b) formula

(c) molar

(d) molecular

10. If 24 g of carbon is measured on a balance, how many atoms have been indirectly counted?

(a) 2×10^{23}

(b) 24×10^{23}

(c) 6.02×10^{23}

(d) 12.04×10^{23}

11. Which element has a molar mass of 31 g/mole?

(a) Potassium

(b) Phosphorus

(c) Gallium

(d) Palladium

12. Calculate the formula mass of Pb_3O_4 (Pb=207, O=16)

(a)458g

(b) 685g

(c) 392g

(d) 223g

13. Calculate the percentage by mass of Ca in Calcium hydroxide [$Ca(OH)_2$] ; Ca=40g, H=1, O=16

(a) 57%

(b) 74.0%

(c) 54.1%

(d) 5.14%

14. Calculate the mass of 1 atom of Sodium (Na)

(a) 3.82×10^{-23}

(b) 6.02×10^{-24}

(c) 3.82×10^{23}

(d) 6.02×10^{24}

15. What is the number of moles in 10.8g of silver (Ag = 108g)

(a) 10 moles

(b) 4 moles

(c) 3.2 moles

(d) 0.1 mole

16. The molar volume of oxygen (O2) gas as s.t.p. is

(a) 16dm^3

(b) 18.4dm^3

(c) 22.4dm^3

(d) 24dm^3

17. 1 mole of hydrogen gas (H_2) is equivalent to all of these except?

(a) 22.400dm^3

(b) 6.02×10^{23}molecules

(c) 12.000g

(d) 2.016g

18. Find the number of moles of 82g of oxygen (O_2) gas

(a) 4.0 moles

(b) 3.2 moles

(c) 6.24 moles

(d) 5.13 moles

19. Calculate the number of moles of 6g of trioxonitrate (v) acid; [H=1, N=14, O=16]

(a) 0.095 mole

(b) 9.05 moles

(c) 0.95 mole

(d) 0.32 mole

20. Calculate the number of atoms of elements in 18.63g of lead; [Pb=207g].

(a) 3.82×10^{23}

(b) 5.4×10^{22}

(c) 3.82×10^{22}

(d) 5.4×10^{23}

21. The relationship; $\frac{Mass}{Relative\ \ molecular\ \ \ mass}$ gives the ratio of

    (a) Molecular mass

    (b) Molar mass

    (c) Mass

    (d) Mole

22. Find the number of g-molecules of oxygen in 6.023×10^{24} CO molecules.

    (a) 10

    (b) 12

    (c) 10.5

    (d) 12.5

23. A mole is equivalent to all but one

    (a) 32g of Oxygen

    (b) 12g of Carbon

    (c) 6.02×10^{23}atoms

    (d) 10g of Calcium.

24. Which of the following is not true?

    (a) 1mole=6.02×10^{23}

    (b) 2g of Hydrogen = 1 mole

    (c) All of the above

    (d) None of the above.

25. Amount of a substance is equivalent to

    (a) Mass

    (b) Relative atomic mass

    (c) Mole

    (d) Relative molecular mass.

26. The mole ratio in which the reactants combine and products are formed, is known as

    (a) Amount of substance

    (b) Displacement

(c) Balancing

(d) Stoichiometry

27. How many moles of hydrogen ions are produced in the reaction: $H_2SO_4 \rightarrow 2H^+ + SO^{2-}$

(a) 5
(b) 1
(c) 2
(d) 4

28. The amount of substance in exactly 12g of carbon-12 is

(a) Carbon atom
(b) mole
(c) mass number
(d) atomic mass.

29. The amount of product actually produced by a chemical reaction is referred to as

(a) Theoretical Yield
(b) Actual Yield
(c) Percentage yield
(d) Limiting reactant

30. Effective calculation of mole requires adequate knowledge of

(a) Balancing equation

(b) The molecule or atom

(c) 1 mole is equivalent to Avogadro's constant.

(d) All of the above

Thank you for your time!

Appendix B: Self-Efficacy Questionnaire (SEQ)

DEPARTMENT OF SCIENCE EDUCATION

FACULTY OF EDUCATION

AHMADU BELLO UNIVERSITY, ZARIA

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

Age: …………….. Class: ……………… Gender: ……………….. Time allowed: 20 Minutes

General Information

This test is meant to assess the level of student's self-efficacy, self-confidence and self-evaluation. Please answer them like you are describing yourself with all sincerity as you see yourself. It is meant for research purpose which will improve teachers' method of teaching and better students' self-efficacy and performance in chemistry.

Instruction: Tick the most applicable to you as a person

SA=Strongly Agreed, A=Agreed, UD=Undecided, D=Disagreed, SD=Strongly Disagreed

S/N	**QUESTION**	**SA**	**A**	**UD**	**D**	**SD**
1.	I am adequately interested in chemistry.					
2.	Chemistry is my worst subject in school.					
3.	Hearing of chemistry creates fear and hatred in me.					
4.	I think I will perform poorly in chemistry.					
5.	I often study my chemistry with eagerness.					
6.	My class mates are better than me in chemistry.					
7.	I am disappointed about my performance in chemistry.					
8.	I do not think I can improve in chemistry even if I work hard.					
9.	I feel like sleeping whenever chemistry class is on.					
10.	Lack of understanding makes me give up in chemistry.					
11.	I have self-confidence to solve problem in Mole Concept.					
12.	I believe that if I fail, I can succeed if I try again.					
13.	When problem come up in Mole Concept, I face them.					
14.	I feel sure of myself when I run into problem.					
15.	I always try to attempt questions that look too difficult.					
16.	I am certain of my ability to be asuccessful chemist.					
17.	I view the chance of failing in chemistry as a challenge.					
18.	I need to memorize to pass my chemistry examinations.					
19.	I will not do any course in the higher institution that is related to chemistry.					
20.	I would like chemistry better if I have better guidance.					

Thank you for your time

Appendix C

PERSONALIZED-LEARNING STRATEGY LESSON PLAN

Experimental Group

Lesson Plan for Week One

School:	GSS Aminu
Date:	
Time:	
Period:	
Duration:	120 Minutes
Average Age of Students:	15 Years
Sex:	Mixed
Subject:	Chemistry
Class:	SS 2
Number of Students:	54
Topic:	Mole
Reference Material:	Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges*.Ibadan, GbabeksPublishers Limited. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools*.Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objectives:	By the end of the lesson students should be able to: i. defines and explain mole, ii. list at least three elementary units of chemical substance, and iii. state at least two importance of mole to chemists
Previous Knowledge:	Students are familiar with chemical symbol, atoms, elements and compounds in chemistry.

Introduction: The teacher introduces the lesson by asking questions from the previous lesson.

Presentation: The teacher presents the lesson using the following steps:

Step 1 The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.

Step 2 Personalized-Learning Strategy was conducted as follows: printed materials based on mole was given to each student to read. They were required to explain mole in their own understanding, list 2 elementary units of chemical substances and to state 2 importance of mole to chemists on their student worksheet. The teacher went round as facilitator to ensure each student was doing the right thing.

Step 3 Each student discusstheir work to a gathering of their teacher and colleagues who makes observation or contribution that serves as feedback on their progression and plan for new investigations or re-teaching.

Step 4 The teacher evaluates the students based on the stated behavioural objectives which are:

i. define mole,
ii. list 3 elementary units of chemical substances, and
iii. state 2 importance of mole to chemists.

Summary: The teacher concludes the lesson by summarizing the main points of the lesson.

Conclusion: The teacher concludes the lesson by giving the students some practice assignments for better understanding of mole and to give feedback in the next class.

Count and relate the following to amount of substance:

a. the number of match stick in a match box
b. the number of eggs in a crate
c. the number of Coca-Cola bottles in a crate.

Lesson Plan for Week Two

School:	GSS Aminu
Date:	
Time:	
Period:	
Duration:	120 Minutes
Average Age of Students:	15 Years
Sex:	Mixed
Subject:	Chemistry
Class:	SS 2
Number of Students:	54
Topic:	Stoichiometry and chemical equations
Reference Material:	Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges.*Ibadan, GbabeksPublishers Limited. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objectives:	By the end of the lesson students should be able to: i. define stoichiometry ii. identify mole ratio(s) of a given chemical equations iii. list 2 steps to follow when solving a stoichiometry problem iv. state at least 3 chemical quantities and their units.
Previous Knowledge:	Students are familiar with mole and its elementaryunits.
Introduction:	The teacher introduces the lesson by asking students to give feedback from their task at home.
Presentation:	The teacher presents the lesson in the following steps:

Step 1

The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.

Step 2

Personalized-Learning Strategy was conducted as follows: printed materials based on stoichiometry and chemical equations was given to each student to read. They were required to write down what stoichiometry is, write down the mole ratios of a given chemical equation, list 2 steps to follow in solving stoichiometry problems and to write down 3 chemical quantities and their units on their worksheet and submit to their teacher. The teacher went round as a facilitator to make sure each student was carrying out their individual task and offered guide where necessary.

Step 3

Each studentdiscuss their work based on what they have written down on their worksheet to a gathering of their teacher and colleagues. The teacher makes a general observation and corrections based on individuals' discussion.

Step 4

The teacher evaluates the students based on the stated behavioural objectives which are:

i. what is stoichiometry?
ii. identify the mole ratio of: $HCl + NaOH \rightarrow NaCl + H_2O$
iii. list 2 steps to follow in solving a stoichiometry problem
iv. state 3 chemical quantities and their units.

Summary:

The teacher summarizes the lesson by highlighting the major points.

Conclusion:

The teacher concludes the lesson by giving assignments

Assignment:

Write 5 chemical equations and indicate their mole ratios.

Lesson Plan for Week Three

School: GSS Aminu

Date:

Time:

Period:

Duration: 120 Minutes

Average Age of Students: 15 Years

Sex: Mixed

Subject: Chemistry

Class: SS 2

Number of Students: 54

Topic: Balancing of chemical equation

Reference Material: Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges.*Ibadan, GbabeksPublishers Limited.
Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.

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

i. explain what chemical equations are,
ii. balance at least 2 given simple chemical equations, and
iii. solve problems based on balanced chemical equation.

Previous Knowledge: Students have been taught stoichiometry and chemical equations.

Introduction: The teacher introduces the lesson by stating the objectives of the lesson.

Presentation: The teacher presents the lesson in the following steps:

Step 1

The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.

Step 2

Personalized-Learning Strategy was conducted as follows: printed materials based on balancing of chemical equations was given to each student to read. They were required to write down the meaning of chemical equation, copy and balance 2 chemical equations from the printed materials and solve at least 1 problem on a given balanced chemical equation in their worksheet. The teacher went round to guide the students as they carry out the given task.

Step 3

The students discuss their work individually from what they have written down on their worksheet to the general class. The teacher makes a general observation and corrections based on individuals' discussion.

Step 4

The teacher evaluates the students based on the stated behavioural objectives which are:

i. What is a chemical equation?

ii. Balance the equation:

$H_2SO_{4(aq)} + KOH_{(aq)} \quad \rightarrow \quad K_2SO_{4(aq)} + H_2O_{(l)}$

iii. Given the equation for the preparation of chlorine as:

$MnO_{2(s)} + 4HCl_{(aq)} \quad \rightarrow \quad MnCl_{(aq)} + Cl_{2(g)} + 2H_2O_{(l)}$

Calculate;

a. the mass of hydrochloric acid required to react with 25g of manganese (iv) oxide.

b. the mass of chlorine gas produced by the reaction.

Summary: The teacher summarizes the lesson by givingthe students the following assignment to be solved individually at home:

i. Differentiate between reactants and products.

ii. Balance the equation:

$CuO_{(s)} + HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)}$

Lesson Plan for Week Four

School:	GSS Aminu
Date:	
Time:	
Period:	
Duration:	120 Minutes
Average Age of Students:	15 Years
Sex:	Mixed
Subject:	Chemistry
Class:	SS 2
Number of Students:	54
Topic:	Application of the Mole Concept
Reference Material:	Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges.*Ibadan, GbabeksPublishers Limited. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objectives:	By the end of the lesson students should be able to: i. define atom ii. differentiate between atom and mole of an element and iii. whatis a molecule?
Previous Knowledge:	Students have learnt how to balance chemical equations and to solve problems involving chemical equations.
Introduction:	The teacher introduces the lesson by asking questions from the previous class assignment.
Presentation:	The teacher presents the lesson in the following steps:

Step 1	The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.
Step 2	Personalized-Learning Strategy was conducted as follows: printed materials based on application of mole concept was given to each student to read. They were required to write what an atom is, write the differences between atoms and moles and to state what molecules are. The teacher guides the students as they carry out the given task.
Step 3	The students discuss their work individually from what they have written down on their worksheet to the general class while the teacher makes a general observation and corrections after the presentation.
Step 4	The teacher evaluates the students based on the stated behavioural objectives which are: i. Define atom ii. Differentiate between atom and mole of an element iii. What is a molecule
Summary:	The teacher summarizes the lesson by clarifying areas that students need help.
Conclusion:	The teacher concludes the lesson by giving assignment:

1. Calculate the moles of NaOH required to neutralize 0.025mole of HCl?
2. Calculate the mass of tetraoxosulphate (VI) acid required to neutralize completely 0.115mol of sodium hydroxide. [H_2SO_4=98]
3. Calculate the number of moles of KOH required to neutralize 1.25moles of HCl completely?

Lesson Plan for Week Five

School: GSS Aminu

Date:

Time:

Period:

Duration: 120 Minutes

Average Age of Students: 15 Years

Sex: Mixed

Subject: Chemistry

Class: SS 2

Number of Students: 54

Topic: Calculations using Mole Concept

Reference Material: Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges.*Ibadan, GbabeksPublishers Limited.
Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.

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

i. calculates the molar mass of a given substance,

ii. calculate the amount of a substance and

iii. relate mass, molar mass and amount of a given substance,

Previous Knowledge: Students are familiar with the application of Mole Concept in solving problems.

Introduction: The teacher introduces the lesson by writing the topic for the day on the chalk board.

Presentation: The teacher presents the lesson in the following steps:

Step 1 The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning

Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.

Step 2

Personalized-Learning Strategy was conducted as follows: printed materials based on calculations using Mole Concept was given to each student to read. They were required to write down and calculate the molar mass of a given equation, calculate the amount of substance and relate mass, molar and amount of a given substance from the equation. The teacher goes round as facilitator to ensure the students are doing what is required and offered help where necessary.

Step 3

The students present and discuss their work based on calculations using Mole Concept to a gathering of the colleagues and teacher. The teacher makes a general observation on the entire students' presentation.

Step 4

The teacher evaluates the lesson based on the following:

i. calculate the molar mass of the following compounds:
a. $MgCO_3$ [Mg=24, C=12, O=16]
b. $CaCO_3$ [Ca=40, C=12, O=16].
ii. how many moles are in 10.0g of sodium hydroxide [NaOH=40g/mol]
iii. What is the mass of 0.105mol of sodium hydrogen tetraoxosulphate (VI), $NaHSO_4$? [$NaHSO_4$ = 120g/mol].

Summary:

The teacher summarizes the lesson by highlightingthe relationships between mass, molar mass and mole of a substance.

Lesson Plan for Week Six

School: GSS Aminu

Date:

Time:

Period:

Duration: 120 Minutes

Average Age of Students: 15 Years

Sex: Mixed

Subject: Chemistry

Class: SS 2

Number of Students: 54

Topic: Avogadro’s Number

Reference Material: Ojokuku, G.O. (2012). *Practical Chemistry for Schools and Colleges.*Ibadan, GbabeksPublishers Limited.
Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.

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

i. state Avogadro’s constant,

ii. relates the mass,molecule, atom and moleof substances to Avogadro’s number and

iii. calculate Avogadro’s number from the mass, molecule and atom of a given substance.

Previous Knowledge: Students have learnt calculations involving molar mass and amountof a given substance in their previous lesson.

Introduction: The teacher introduces the lesson by writing the topic of the lesson on the chalkboard.

Presentation: The teacher presents the lesson in the following steps:

Step 1 The teacher introduces the lesson to the students by giving individuals some activities based on Personalized-Learning Strategy in which the teacher explains to them fully what to do based on Personalized-Learning Strategy.

Step 2 Personalized-Learning Strategy was conducted as follows: printed materials based on Avogadro’s number was given to each student to read. They were required to write down Avogadro’s number, relate the mass, molecule, atom and mole of substances to Avogadro’s number. The teacher goes round as a facilitatorto ensure the students are doing what is required.

Step 3 The students discuss their work on Avogadro’s number to a gathering of the colleagues and teacher. The teacher makes a general observation on the entire students’ presentation.

Step 4 The teacher evaluates the lessonby asking the students the following questions:

i. The number 6.02×10^{23} is referred to as what?

ii. What is the relationship between a mole of a substance and an Avogadro’s number?

iii. Calculate:

a). the number of atoms present in 3.05 moles of Silver

b). the number of molecules in 0.025 mole of Argon

c). the number of moles represents by 2.09×10^{25} atoms

Summary: The teacher summarizes the lesson by highlighting the relevant points to the students for better understanding.

Conclusion: The teacher concludes the lesson by giving the students the following questions as homework:

1. How many molecules are there in 25.5g of ammonia?
2. How many atoms are in 24g of oxygen gas?
3. What would be the mass of 3.01×10^{22} molecules of water?
4. How many moles are in 9.03×10^{23} atoms of sodium? [Na=23]

Appendix D

LECTURE METHOD LESSON PLAN FOR CONTROL GROUP

Lesson Plan for Week One

School:	GSS Muchia
Date:	
Time:	
Period:	
Duration:	120 Minutes
Average Age of Students:	15 Years
Sex:	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Mole Concept
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students should be able to; i. define and explain Mole Concept, ii. list three elementary units of chemical substance, and iii. state the importance of Mole Concept to chemists
Previous Knowledge	Students are familiar with chemical symbol, atoms, elements and compounds in chemistry.
Introduction	The teacher introduces the lesson by asking questions on the previous knowledge.

Presentation The teacher presents the lesson through the following steps:

Step 1 The teacher defines mole as a concept while students listen.

Mole: A mole is the amount of a chemical substance that contains as many elementary units as there are atoms in 12g of carbon-12. It is the unit used to measure the amount of matter in terms of number of particles.

Step 2 The teacher lists elementary units of chemical substances that relates to mole as a concept:

Atoms: Is the smallest particle of an element which can take part in chemical reaction.

Molecules: Is the smallest particle of a substance that is capable of independent existence, and still retains the chemical properties of that substance

Ions: Any atom or a group of atoms which possesses an electric charge. There are two types of ions: positively charged ions as K^+, Na^+, NH_4^+ and negatively charged ions as OH^-, Cl^-, SO_4^{2-}.

Electrons: The electron is a negatively charged, its charge being equal in magnitude but of opposite sign to the charge on a proton.

Step 3 The teacher went further to state the importance of mole concept to chemists:

i. Estimation of quantities of chemical substances
ii. Determination of elementary units of chemical substances

iii. Calculation of number of atoms and molecules

Student Activities: Teacher gives the students room to ask their questions from the lesson learnt and explanations were made for them.

Evaluation: The teacher evaluates the lesson by asking students questions based on the lesson treated such as:

ii. Define mole.

iii. List 3 elementary units of chemical substances.

iv. State 2 importance of Mole Concept to chemists.

Conclusion: The teacher concludes the lesson by summarizing the main points of the lesson and allows students to copy note on their exercise books.

Lesson Plan for Week Two

School	GSS Muchia
Date	
Time	
Period	
Duration	120 Minutes
Average Age of Students	15 Years
Sex	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Stoichiometry and chemical equation
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students will be able to; i. define stoichiometry of a chemical reaction and ii. list some chemical quantities and their unit.
Previous Knowledge	Students are familiar with Mole Concept and its elementary units.
Introduction	The teacher introduces the lesson by asking the student to state what they know on stoichiometry.
Presentation	The teacher presents the lesson through the following steps:

Step 1 The teacher defines stoichiometry as a concept while students listen.

Stoichiometry: Stoichiometry is the mole ratio in which the reactants combines and products are formed. It deals with definite ratios in which substances combine.

Example: $Zn_{(s)}+CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)}+Cu_{(s)}$
Mole ratio: 1 : 1 :1 : 1

Step 2 The teacher lists and explains some chemical quantities and their units:

Mole: The S.I. unit for the amount of substance, it is measured in mole.

Molar mass: The mass of one mole of a substance or compound, it is measured in gram per mole ($gmol^{-1}$).

Molarity: The molarity, M termed molar concentration of a solution is the number of moles of solute per dm^3 of solution. It is measured in mole per dm^3 ($moldm^{-3}$).

Relative molecular mass: The mass of one mole of a molecule, measured in atomic mass unit (amu).

Student Activities: The teacher went ahead to ask the students to explain stoichiometry in their own understanding.

Evaluation: The teacher evaluates the lesson by asking students the following questions:

i. Define stoichiometry?
ii. List 3 chemical quantities and their units.

Conclusion: The teacher concludes the lesson by writing note for the students on the chalkboard.

Lesson Plan for Week Three

School	GSS Muchia
Date	
Time	
Period	
Duration	120 Minutes
Average Age of Students	15 Years
Sex	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Balancing of chemical equation
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students will be able to; i explain what chemical equations are, ii write and balance simple chemical equations, and iii solve problems based on balanced chemical equation.
Previous Knowledge	Students have been taught stoichiometry and chemical quantities.
Introduction	The teacher introduces the lesson by asking the students to explain what stoichiometry is and list 3 chemical quantities & their units.

Presentation:	The teacher presents the lesson using the following steps:

Step 1: The teacher explains what chemical equation is all about.

Viz:

Chemical equations are representations of chemical reactions in terms of symbols and formulae of the elements and compounds involved. The substances that participate in the reaction, that is, reactants, are written on the left-hand side, while the products of the reaction are written on the right hand side. Reactants and products are linked together by an arrow symbol (→) whose head points towards the products.

A + B → **C + D**

(Reactants) (Products)

Step 2: The teacher writes simple chemical equations on the chalkboard and explained to the students on how to balance them.

$3H_{2(g)} + N_{2(g)} \rightarrow 2NH_{3(g)}$

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$

$2HCl_{(aq)} + Na_2CO_{3(aq)} \rightarrow 2NaCl_{(aq)} + CO_{2(g)}+H_2O_{(l)}$

$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Step 3: The teacher went further to explain to the students how to perform basic calculations using balanced chemical equations.

1. Calculate the mass of sodium trioxonitrate (iv) produced by complete decomposition of 16.8g of sodium hydrogen trioxocarbonate (iv).

Equation for the reaction:

$2NaHCO_{3(g)} \rightarrow Na_2CO_{3(g)} + H_2O_{(g)} + CO_{2\,(g)}$

168g of $NaHCO_3$ produced 106g of Na_2CO_3

16.8g of $NaHCO_3$ will produce x(g) of Na_2CO_3

$x\ (g) = \frac{106\times16.8}{168} = 10.6g$ of Na_2CO_3

Student Activities: The teacher asks the students to balance the following equations:

i. $NH_{3(g)} + O_{2(g)} \rightarrow H_2O_{(g)} + N_{2(g)}$

ii. $NH_{3(g)} + O_{2(g)} \rightarrow NO_{(g)} + H_2O_{(g)}$

Evaluation: The teacher evaluates the lesson by asking students the following questions:

i. Differentiate between reactants and products.
ii. Balance the following equations:
a). $CuO_{(s)} + HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)}$
b). $H_2SO_{4(aq)} + KOH_{(aq)} \rightarrow K_2SO_{4(aq)} + H_2O_{(l)}$
iii. Given the equation for the preparation of chlorine as:

Conclusion: The teacher concludes the lesson by writing note for the students on the chalkboard.

Lesson Plan for Week Four

School	GSS Muchia
Date	
Time	
Period	
Duration	120 Minutes
Average Age of Students	15 Years
Sex	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Application of the Mole Concept
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students will be able to; i. define atom, distinguish between atoms and moles of an element and ii. state what molecules are and its relation to mole.
Previous Knowledge	Students have learnt balancing of chemical equations and calculations involving chemical equations.
Introduction	The teacher introduces the lesson by asking the students to define atoms and molecules.
Presentation:	The teacher presents the lesson through the following steps:

Step 1: The teacher explains what atoms are and its relationship to mole.

An atom is the smallest particle of an element which can take part in chemical reaction. Examples includes: Hydrogen atom, Oxygen atom, Nitrogen atom, Sodium atom, and so on.

While,

A mole is a collection of atoms of an element. Examples include: 2 moles of hydrogen ($2H_2$), 5 moles of sodium ($5Na$).

Step 2 The teacher explains molecules and states its relationship to mole.

A molecule is the smallest particle of a substance that is capable of independent existence and still retains the chemical properties of that substance. A molecule is formed when two or more atoms are chemically joined together.

The combination of atoms of the same type produces molecule of an element; Examples: H_2, O_2, Cl_2, and so on.

While,

The combination of different types of atoms produces molecule of a compound, for example: $NaCl$, H_2O, $CaCl_2$, HCl, and so on.

Step 3 The teacher explains mass of an element and state its relationship to mole.

A mass of an element is the sum of the protons and the neutrons in the atomic nucleus of the element. It is represented by number referred to as mass number also referred to as atomic mass.

Mole represents the molar mass of a substance in grams.

I mole of HCl = 36.5g

40g of NaOH = 1 mole

Example:

1. Calculate the number of moles of NaOH required to neutralize 0.5mole of HCl?

   $HCl + NaOH \rightarrow NaCl + H_2O$

   1mol 1mol

   1 mol of HCl requires 1 mol of NaOH

   0.5mol of HCl will require x mol of NaOH

   Therefore, $x = \frac{1\times0.5}{1} = 0.5\,mol\;of$ NaOH

2. Calculate the mass of tetraoxosulphate (VI) acid required to neutralize completely 0.1mol of potassium hydroxide. [H_2SO_4=98]
   The equation of reaction is:
   $H_2SO_{4(aq)} + 2KOH_{(aq)} \rightarrow K_2SO_{4(aq)} + H_2O_{(l)}$
   1 mol 2mol

   2 moles of KOH = 1 mol of H_2SO_4

   2 moles of KOH = 98g of H_2SO_4

   0.1 mol of KOH = x (g) of H_2SO_4

   $x(g) = \frac{0.1\times98}{2} = 4.90gofH_2SO_4$

Student Activities: The teacher allowed the students to ask their questions and clarifications were made.

Evaluation: The teacher evaluates the lesson by asking the following questions:

i. What is the difference between atom and mole of an element?
ii. List 3 examples each of molecules of the same atoms and molecules of different atoms.
iii. Calculate the mass of H_2SO_4 requires to neutralize of 0.25mole of NaOH [H2SO4=98, NaOH=40].

Conclusion: The teacher concludes the lesson by writing note for the students on the chalkboard.

Lesson Plan for Week Five

School	GSS Muchia
Date	
Time	
Period	
Duration	120 Minutes
Average Age of Students	15 Years
Sex	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Calculations using Mole Concept
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students will be able to; i. calculates the molar mass of a substance, and ii. calculate the amount of a substance.
Previous Knowledge	Students have been taught the application of Mole Concept in solving problems.
Introduction	The teacher introduces the lesson by writing the topic for the day on the chalkboard.
Presentation	The teacher presents the lesson using the following steps:

Step 1

The teacher writes some compounds and went ahead to calculate their molar mass.

i. Tetraoxosulphate (VI) acid, H_2SO_4 [H=1, S=32, O=16]

H_2	S	O_4
(2×1) +	32 +	(4×16) = 98gmol^{-1}

ii. Calcium trioxonitate (V), $Ca(NO_3)_2$ [Ca=40, N=14, O=16]

Ca	N_2	O_6
40 +	(2×14) +	(6×16) = 164gmol^{-1}

iii. Iron (III) oxide, Fe_2O_3 [Fe=55.8, O=16]

Fe_2	O_3
(2×55.8) +	(3×16) = 159.6gmol^{-1}

Step 2

The teacher explains to the students how to calculate number of moles of a substance (amount).

The mathematical formula that connects the mole, mass and molar mass of a chemical substance is;

$$Amount, n(mol) = \frac{Mass, m(g)}{Molar\ mass, M(g/mol)}$$

Example:

1. How many moles of oxygen are present in 16g of oxygen gas?

$$n = \frac{Mass}{Molar\ mass}$$

$$n\ \frac{16}{32} = 0.5moles$$

2. Calculate the mass of iron present in 0.025mol of iron filings. [Fe=56.0g/mol]

$$Amount = \frac{Mass}{Molar\ mass}$$

$$Mass\ of\ iron = No.of\ moles\ of\ iron \times molar\ mass\ of\ iron$$

Mass of iron = 0.025×56 = 1.40g

3. If 0.123mol of an element X weighs 8.0g. What is the molar mass of X?

$$Amount, n(mol) = \frac{Mass, m(g)}{Molar\ mass, M(g/mol)}$$

$$Molar\ mass = \frac{Mass}{Amount}$$

$$Molar\ mass = \frac{8.0}{0.123} = 65g/mol$$

Student Activities: The teacher gives the students a question to solve:

What is the mass of 0.105mol of sodium hydrogen tetraoxosulphate (VI), $NaHSO_4$? [$NaHSO_4$ = 120g/mol]

Evaluation: The teacher evaluates the lesson by asking students the following questions:

i. calculate the molar mass of the following compounds:
   a. $MgCO_3$ [Mg=24, C=12, O=16]
   b. $CaCO_3$ [Ca=40, C=12, O=16].
ii. how many moles are in 10.0g of sodium hydroxide [NaOH=40g/mol]

Conclusion: The teacher concludes the lesson by writing note for the students on the chalkboard.

Lesson Plan for Week Six

School	GSS Muchia
Date	
Time	
Period	
Duration	120 Minutes
Average Age of Students	15 Years
Sex	Mixed
Subject	Chemistry
Class	SS 2
Number of Students:	89
Topic	Avogadro’s Number
Reference Material	Ojokuku, G.O. (2012).*Practical Chemistry for Schools and Colleges Gbabeks* Publishers Limited, Ibadan. Odesina, I.A. (2015). *Essential Chemistry for Senior Secondary Schools.*Ogun State, Nigeria, Tonad Publishers Limited.
Behavioural Objective	By the end of the lesson students will be able to; i. state Avogadro’s constant, ii. relates the mass, molecule, atom and mole of an element to Avogadro’s number.
Previous Knowledge	Students have learnt how to calculate molar mass and amount of substance in their previous class.
Introduction	The teacher introduces the lesson by writing the topic on the chalkboard and asking students to state what they know about it.
Presentation	The teacher presents the lesson through the following steps:

Step 1 The teacher explains Avogadro's constant and its usefulness in chemical reactions.

Avogadro's constant is the number of specified particles present in one mole of a substance. One mole of an element contains a fixed number of atom termed Avogadro's constant, that is, 6.02×10^{23} atoms.

Step 2 The teacher states the relationships between Avogadro's number, molar mass, number of atom, molecule and mole.

1 mole of an element = molar mass of the element
1 mole of an element = 6.02×10^{23} atoms of the element
1 mole of an element = 6.02×10^{23} molecules of the element

Therefore,

$$Avogadro's\ constant = \frac{Number\ of\ atom}{Amount}$$

Example: How many atoms are in 2g of calcium? [Ca=40]

1 mole of Ca = 40g = 6.02×10^{23} atoms

2g of Ca = x atoms

$$x\ (atoms) = \frac{2 \times 6.02 \times 10^{23}}{40} = 3.01 \times 10^{22}$$

Alternatively,

$$Avogadro's\ constant = \frac{Number\ of\ atom}{Amount}$$

Number of atom = Avogadro's constant × Amount

No. of atom = $Avogado'sconstant \times \frac{mass}{Molar\ \ mass}$

$$No. of\ atom = 6.02 \times 10^{23} \times \frac{2}{40}$$

No. of atom = 3.01×10^{22}

Student Activities: The teacher asks the students to calculate the number of atoms present in 2.5 moles of Calcium.

Evaluation: The teacher evaluates the lesson by asking students the following questions:

i. The number 6.02×10^{23} is referred to as what?

ii. Calculate:

a). the number of atoms present in 3.05 moles of Silver

b). the number of molecules in 0.025 mole of Argon

c). the number of moles represents by 2.09×10^{25} atoms

Conclusion: The teacher concludes the lesson by writing note for the students on the chalkboard.

Appendix E

Marking Scheme for MCPT

1. **A**
2. **A**
3. **C**
4. **D**
5. **B**
6. **D**
7. **B**
8. **A**
9. **C**
10. **D**
11. **B**
12. **B**
13. **C**
14. **A**
15. **D**
16. **C**
17. **C**
18. **D**
19. **A**
20. **B**
21. **D**
22. **A**
23. **D**
24. **D**
25. **C**
26. **D**
27. **C**
28. **B**
29. **B**
30. **D**

Appendix F: Pilot testing result for MCPT

```
GET DATA /TYPE=XLSX
  /FILE='C:\Users\PRUDY\Desktop\Pilot Study.xlsx'
  /SHEET=name 'MCPT'
  /CELLRANGE=full
  /READNAMES=on
  /ASSUMEDSTRWIDTH=32767.
EXECUTE.
DATASET NAME DataSet1 WINDOW=FRONT.
CORRELATIONS
  /VARIABLES=MCPT1 MCPT2
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

Correlations

		MCPT1	MCPT2
MCPT1	Pearson Correlation	1	.808**
	Sig. (2-tailed)		.000
	N	20	20
MCPT2	Pearson Correlation	.808**	1
	Sig. (2-tailed)	.000	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix G: Pilot testing result for SEQ

```
DATASET ACTIVATE DataSet1.
DATASET CLOSE DataSet3.
GET DATA /TYPE=XLSX
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Study.xlsx"
  /SHEET=name 'SEQ'
  /CELLRANGE=full
  /READNAMES=on
  /ASSUMEDSTRWIDTH=32767.
EXECUTE.
DATASET NAME DataSet4 WINDOW=FRONT.
CORRELATIONS
  /VARIABLES=SEQ1 SEQ2
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

		SEQ1	SEQ2
SEQ1	Pearson Correlation	1	.898**
	Sig. (2-tailed)		.000
	N	20	20
SEQ2	Pearson Correlation	.898**	1
	Sig. (2-tailed)	.000	
	N	20	20

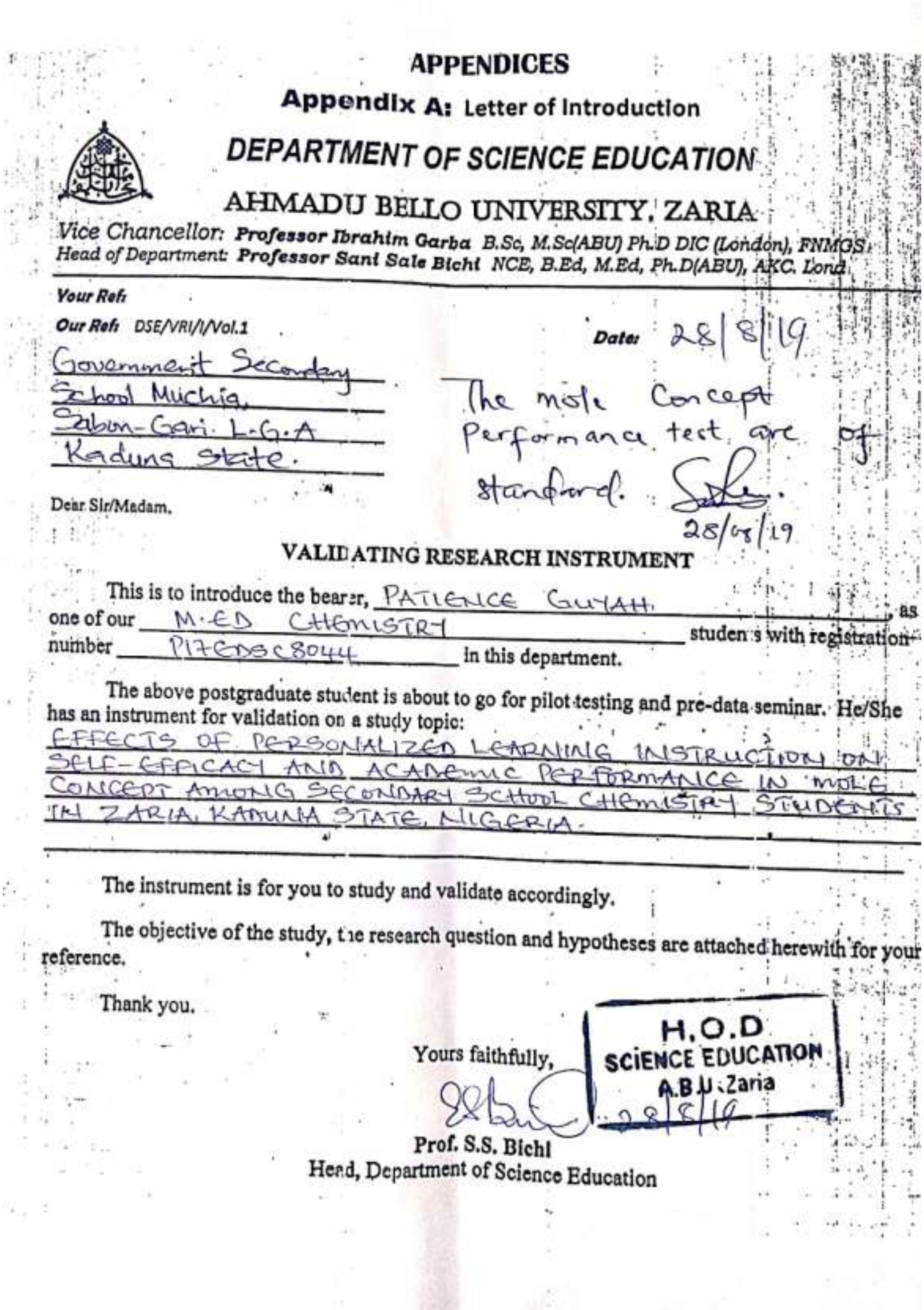
**. Correlation is significant at the 0.01 level (2-tailed).

Appendix H: Population of the Study

S/N	Name of School	Type	Number of Students		
			Males	**Females**	**Total**
1.	GSS Bomo	Co-education	87	61	148
2.	GSS Kwangila	Co-education	103	50	153
3.	GSS Jama'a	Co-education	45	38	83
4.	GSS Basawa	Co-education	56	42	98
5.	GSS Muchia	Co-education	45	44	89
6.	GSS Sakadadi	Co-education	27	13	40
7.	GSS Aminu	Co-education	20	34	54
8.	GCC Zaria	Co-education	39	47	86
9.	GSS Zaria	Co-education	215	-	215
10.	GSS Magajiya	Co-education	184	86	270
11.	GSSS Kaura	Co-education	206	153	359
12.	GSS T/Saibu	Co-education	90	44	134
13.	GSS K/Kuyanbana	Co-education	133	84	217
14.	GSS T/Jukun	Co-education	102	161	263
15.	GSS Dakace	Co-education	112	64	176
16.	GSS Gyalesu	Co-education	187	99	286
17.	GSS Bogari	Co-education	38	1	39
18.	SIASSS K/Karau A	Co-education	42	10	52
19.	SIASSS K/Karau B	Co-education	114	141	255
20.	GSS Likoro	Co-education	34	20	54
21.	GSS Awai	Co-education	22	6	28
22.	GSS Yakasai	Co-education	30	15	45
23.	GSS Richifa	Co-education	30	6	36
24.	GSS Kugu	Co-education	96	14	110
25.	GSS Dinya	Single (Boys)	31	-	31
26.	SSS Kufena	Single (Boys)	210	-	210
27.	Alhudahuda College	Single (Boys)	890	-	890
28.	Barewa College	Single (Boys)	478	-	478
29.	GSS Chindit	Single (Boys)	250	-	250
30.	GGSS Samaru	Single (Girls)	-	185	185
31.	GGSS Chindit	Single (Girls)	-	292	292
32.	GGSS Dogon-Bauchi	Single (Girls)	-	247	247
33.	GGSS Zaria	Single (Girls)	-	162	162
34.	GGSS K/Gayan	Single (Girls)	-	288	288
35.	GGSS Pada	Single (Girls)	-	204	204
Total			**3, 916**	**2, 611**	**6, 527**

Source: Kaduna State Ministry of Education, Science and Technology. Zaria Zonal Education Office (2018).

Appendix I: Research Instrument Validation Letter



APPENDICES

Appendix A: Letter of Introduction

DEPARTMENT OF SCIENCE EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA
Vice Chancellor: **Professor Ibrahim Garba** B.Sc, M.Sc(ABU) Ph.D DIC (London), FNMGS
Head of Department: **Professor Sani Sale Bichi** NCE, B.Ed, M.Ed, Ph.D(ABU), AKC. Lond

Your Ref:
Our Ref: DSE/VRI/I/Vol.1

Date: 28/8/19

Government Secondary
School Muchia,
Sabon-Gari L.G.A
Kaduna State.

The mole Concept
Performance test are of
standard.
28/08/19

Dear Sir/Madam,

VALIDATING RESEARCH INSTRUMENT

This is to introduce the bearer, PATIENCE GUYAH, as one of our M.ED CHEMISTRY students with registration number P17EDSC8044 in this department.

The above postgraduate student is about to go for pilot testing and pre-data seminar. He/She has an instrument for validation on a study topic: EFFECTS OF PERSONALIZED LEARNING INSTRUCTION ON SELF-EFFICACY AND ACADEMIC PERFORMANCE IN MOLE CONCEPT AMONG SECONDARY SCHOOL CHEMISTRY STUDENTS IN ZARIA, KADUNA STATE, NIGERIA.

The instrument is for you to study and validate accordingly.

The objective of the study, the research question and hypotheses are attached herewith for your reference.

Thank you.

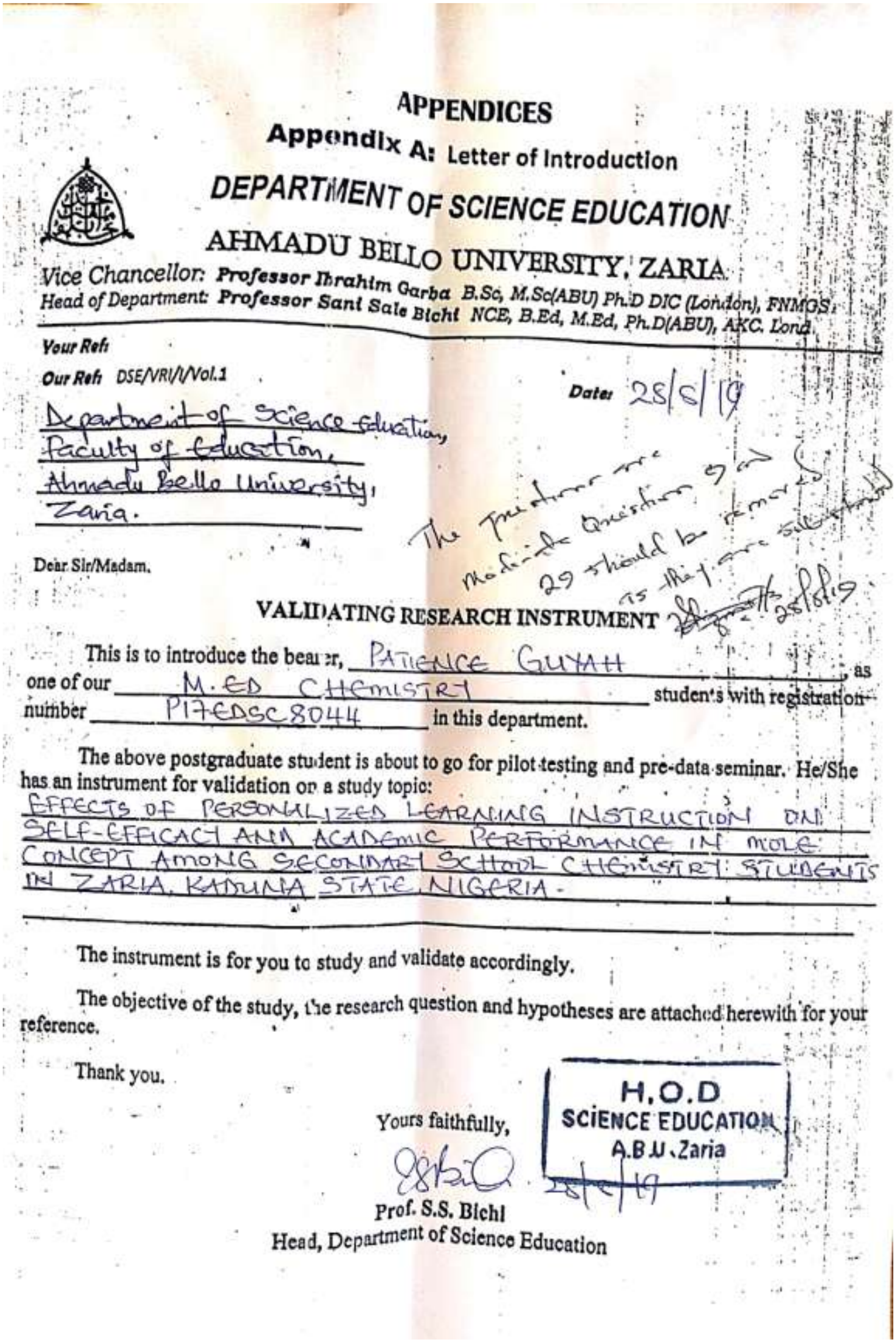
Yours faithfully,

H.O.D
SCIENCE EDUCATION
A.B.U. Zaria
28/8/19

Prof. S.S. Bichi
Head, Department of Science Education

APPENDICES

Appendix A: Letter of Introduction



DEPARTMENT OF SCIENCE EDUCATION

AHMADU BELLO UNIVERSITY, ZARIA

Vice Chancellor: **Professor Ibrahim Garba** *B.Sc, M.Sc(ABU) Ph.D DIC (London), FNMGS*

Head of Department: **Professor Sani Sale Bichi** *NCE, B.Ed, M.Ed, Ph.D(ABU), AKC. Lond*

Your Ref:

Our Ref: DSE/VRI/I/Vol.1

Date: 28/8/19

Department of Science Education,
Faculty of Education,
Ahmadu Bello University,
Zaria.

The questions are modified. Question 9 and 29 should be removed as they are similar 28/8/19

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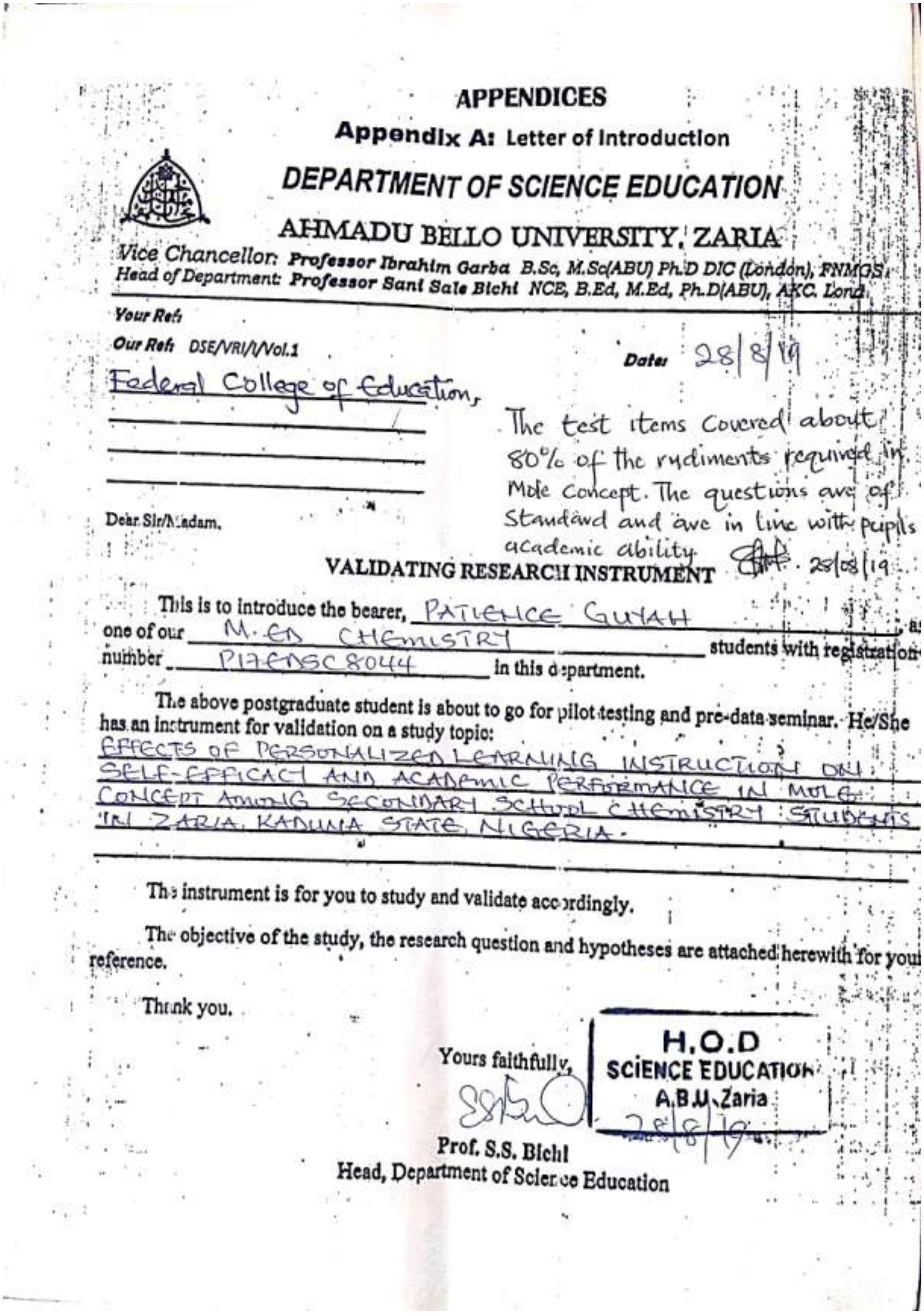
SCIENCE EDUCATION
A.B.U. Zaria
28/8/19



APPENDICES

Appendix A: Letter of Introduction

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Your Ref:

Our Ref: DSE/VRI/I/Vol.1

Date: 28/8/19

Federal College of Education,

The test items covered about 80% of the rudiments required in Mole Concept. The questions are of Standard and are in line with pupils academic ability. 28/08/19

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28/8/19