EFFECTS OF PROJECTED INSTRUCTIONAL MEDIA ON SECONDARY SCHOOL STUDENTS ACHIEVEMENT AND RETENTION IN CHEMISTRY IN BOSSO LOCAL GOVERNMENT AREA OF MINNA, NIGER STATE

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ABSTRACT

Chemistry which is not just a subject but also one of the most important foundation for nearly all fields of life. In Nigeria, in spite of the importance of chemistry for national advancement, the persistent under-performance and poor achievement of students in chemistry at the senior secondary school level in the past decade has been a matter of serious concern to Educationalist and other stakeholders. It is not clear if lack of application of instructional media by chemistry teachers is the causative factor for this development. This necessitated the present study to determine the effects of projected instructional media on secondary school student's achievement and retention in chemistry in Bosso Local Government Area of Minna, Niger State. The quasi experimental design was employed in the study with a pretest and posttest equivalent group design. Among 10,204 students in Bosso Niger state, eighty (80) students were drawn from two (2) schools. Mean and standard deviation were used to answer the research questions and T-Test was used to test the hypothesis at 0.05 level of significance. Findings indicated that students taught using projected instructional media achieved and retained facts better than those taught using conventional method, male and female students taught using projected instructional media achieved a significant different scores (achievement). Instructional media which includes computers, multimedia, slides, television, projectors and others are recommended to be made available in the schools to make teaching more effective and result oriented.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The quality of every society is largely based on the quality of its educational system. Education is the principal tool for academic progress, social mobilization, political persistence and effective national development of any country. Also, educational undertakings which majorly involves teaching and learning is very pivotal in our society and if it is properly planned and implemented, it can lead to an extraordinary level of achievement for the country as a whole. In other words, it is essential for there to be effective teaching and learning methods so as to improve on effective educational process. As a result, there is a need to make use of teaching instructional media which include the use of audio-visual instructional media to enhance the teaching-learning process. This concept bears credence to the old Chinese adage that states "what I hear I forget, what I remember and what I do, I know".

Projected instructional media are those channels or medium by which information, skills; knowledge among others is communicated to learners during teaching and learning process. It is a means of passing information from a facilitator to the learner. They help in achieving the stated behavioral objectives when assessment is carried out at the end of the lesson or programme (it tests knowledge and ability) and help students to retain knowledge for longer periods (Awolaju, 2015). Such media could be used to carry ideas, knowledge, information and message about what the teacher takes to the students (Amali & Adejoh, 2013).

The use of projected instructional media in teaching and learning is not categorically new. What is innovative, is the technological equipment that have been introduced recently

into the teaching and learning process. With the evolving technology and the new communication media, efforts are on the rise in the application of projected instructional media to learning; a development that has proven to be beneficial to learners. Many teachers are not knowledgeable or find it difficult to use various media aids because of lack of training on its application for effective use and dissemination of knowledge. Science teachers have applied various conventional methods and strategies in teaching chemistry, yet there has been poor performance among secondary school students in the certificate examination throughout the country (WAEC,2018). This has denied many Nigerian students the opportunity of getting admitted into institutions of higher learning.

There has therefore been an uproar from parents, teachers, curriculum planners and other stakeholders in educational industry about the deteriorating achievement of students in chemistry in both internal and external examination in Nigeria.in addressing this issue, the innovation teaching strategies such among other factors have been reported to be a crucial parameter. To comprehend the reactions involved, students mainly need to apply the content knowledge which they have learnt since the use of convention methods do not seem to help students understand most concepts in chemistry, the introduction of new instructional strategy will help students understand these concepts since previous studies have shown that students have difficulties in understanding the reactions involved in chemistry. Rutten, Van jooloinge and Vander Veen (2012) who studied 51 articles from 2001 to 2010 show that traditional classroom can be improved by using computer simulations. Using computer simulations has been reported to enhance learners' experiences up to a maximum effect size of 1.54 (Rutten et al. 2012; Donnelly et al. 2012) and other gains were reported by Howe, Devine and Tavares (2013) where children worked individually.

The lack of involvement of instructional media in many schools today has resulted to ineffectiveness of teaching chemistry, thereby leading to poor achievement and retention in both internal and external examinations. The instructional media are not readily available in many schools and even where they are available, most are not adequately used by the teachers due to lack of knowledge on how to put them to use. According to Njoku in Akoja and Ali (2012), instructional media are those channels of communication which promote the effectiveness of instruction and helps the teacher to communicate ideas effectively to the students. Instructional media are those substitute channels of communication which a teacher can use to concretize a concept during his/her teaching. They include all the materials and considerable resources that an educator might use to implement teaching and facilitate students' achievement of instructional objectives.

Innovative advances in technology according to Guy and Lowness (2015), have introduced a variety of tools to enhance learning in higher education. Instructional media are in various classes, such as audio or aural, visual or audio visual. Thus, audio instructional media refers to those devices that make use of the sense of hearing only, like radio, audio tape recording etc. Visual instructional media on the other hand are those devices that appeal to the sense of sight only such as the chalkboard, chart, slide and filmstrip. An audio-visual instructional media, however, is a device that associates the appeal to the sense of both hearing and seeing such as television, motion picture and computer. It has been widely observed that a visual instructional media helps to make abstract ideas more tangible to the learners and educators have come to a consciousness that effective teaching and learning takes place when an individual has an uninterrupted experience with the subject under study, i.e. learners learn best when they are involved particularly when the use of audio-visual media is involved as this gives them (learners)

a prospect to be more motivated, attentive, concerted and enable for high retention of facts.

According to Feldman (2012) instructional media are substances that leave marks on the learner and the learning situation; he stated clearly that instructional media which precede written text helps to express the psychological dimension of the student's life. Tyler, (2014). These instructional media are resources that a teacher uses to implement instruction and enhance learning as it encourages student's attention and stimulate their interest. It also helps in making learning to become an enjoyable experience (Akoja & Ali 2012). These materials are also required by teachers to assess the knowledge of their students. Teachers often assess students by assigning tasks, creating projects and administering examinations. Instructional materials are essential for all these activities (Crist 2014). Akoja and Ali, (2012) proposed that to enhance effective classroom communication, the teacher should employ different approaches and means which appeal to the senses of the learners. Instructional media in this regard are necessary in stimulating all the five senses such as hearing, touching, seeing, smelling and feeling (Isola, 2010). The study by Akoja and Ali (2012) showed that the use of instructional media promotes a better retention of ideas, making learning more permanent and gives a high degree of interest to students. The utilization of the projected instructional media in teaching and learning of chemistry is essential; this is because projected instructional media are regarded as reinforce of cognitive, affective and psychomotor aspect of learning (Adikwu, 2013). The teaching learning process may lead to an effective retention of knowledge as students tend to remember what they see, touch, feel and manipulate.

Non-application of instructional media is one of the factors that are responsible for poor achievement and retention of students in sciences, technology and mathematics. This

requires the present study to explore the use of instructional media to teach chemical bonding and how this can impact students' achievement and retention in chemistry.

Achievement is the outcome of students or learner's performance resulting from a test or examination. Therefore, it can be maintained that achievement of the students is the demonstration of their capacity to facilitate the learning of theoretical concept and idea, this is because instructional media are regarded as reinforcement of cognitive, affective and psychomotor aspect of learning. The teaching-learning process which can involve the use of instructional media leading to an effective retention of knowledge as students have a tendency to remember what they see, touch, feel and manipulate.

1.2 Statement of the Problem

The study of the concept of chemical bonding as a branch of chemistry has played a vital role in the overall concept of chemistry and its application to physical and organic chemistry. In view of the fact that chemistry is a core subject under the field of science in the senior secondary school curricula and its importance to science oriented courses in the higher institutions, it is expected that students should perform very well in the subject to the point of not only scoring a distinction or credit in any examination, especially the external examination; but that the students should be able to have retention of the course contents. However, findings have shown that in spite of the importance of chemistry for national development, students have not been making good grades in the subject at West African Examination Council (WAEC) or Nigerian Examination Council (NECO) examinations not to talk of retaining the course contents. The persistent poor achievement of students in chemistry in external examination in Niger state in the past decade has become a matter of serious concern to educationists and other stakeholders and the reason for students' poor achievement in chemistry may not be unconnected with the method of teaching which the talk is basically and chalk method of teaching which may have led to

students having difficulty in understanding, assimilating and retaining the chemical concept taught using the conventional method of teaching. Due to variables such as impact of availability, accessibility and the academic performance among senior secondary school chemistry students is generally poor as they often forget what they have taught, over the decades. For example, lack of proper utilization of projected instructional media might have led to the teachers viewing themselves as not well prepared to utilize projector in the classroom, in spite of taking part in staff development programmes relating to projected instructional media.

The researcher believes that the conventional teaching method is not effective enough to equip the students towards achieving good academic performance and having ability to retain what they are taught. This is the reason why the researcher is interested in conducting a study on the effect of projected instructional media on the students' academic achievement in some selected senior secondary schools in Bosso Local Government Area of Niger state.

1.3 Aims and Objectives of the study

The aim of this study is to determine the effect of projected instructional media on students' academic achievement and retention on the "concept of chemical bonding". Specifically, the study seeks to:

(i) Determine the academic achievement and retention of the senior secondary school students taught concept of chemical bonding with conventional method of teaching.

(ii) Ascertain the academic achievement and retention of the senior secondary school students taught concept of chemical bonding with projected instructional media.

(iii) Investigate the difference in the academic achievements and retention of the students taught concept of chemical bonding with the conventional method of teaching and those taught with projected instructional media.

(iv) Examine the influence of gender on the academic performance and retention of the students taught concept of chemical bonding using conventional method of teaching and those taught using projected instructional media.

1.4 Research Questions

In order to achieve the derived objectives of this study, the following research questions are raised.

1) What is the difference in the academic achievement of senior secondary school students taught concept of chemical bonding with projected instructional media and those taught using conventional method of teaching in the selected schools in Bosso area council of Niger state?

2) What is the gender difference between students taught concept of chemical bonding using projected instructional media and those taught using conventional method of teaching?
3) What is the difference in the retention of senior secondary school students taught using projected instructional media and those taught using conventional teaching method?
4) What is the difference in retention between male and female students taught concept of chemical bonding using projected instructional media and those taught using conventional teaching methods?

1.5 Research Hypotheses

HO_1: There is no significant difference on the academic achievement of students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

HO_2: There is no significant difference on the academic achievement between male and female students taught concept of chemical bonding using projected instructional media and those taught using conventional teaching methods.

HO_3: There's no significant difference in the retention of the students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

HO_4: There's no significant difference in the retention between male and female students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

1.6 Scope of the Study

The study will be carried out in Bosso local government area council of Niger state, where the researcher intends to specifically ascertain the effect of projected instructional media on students' achievement and retention on the concept of chemical bonding in cognitive ability tasks in Chemistry using Blooms' lower and higher level of cognitive domain which hierarchically consist to recall knowledge, comprehension and application as the lower cognitive domain and, analysis, synthesis and evaluation which constitute the higher cognitive level.

Academic achievement of students has often been associated with gender and school location. Ezeh, (2013) explains that 'gender describes the personality traits, attitudes, behaviors', values, relative power, influence, roles and expectation (femininity and masculinity) that society ascribes to the two sexes on a differential basis'. Therefore, gender is a psychological term and a cultural construct developed by society to differentiate between the roles, behavior, mental and emotional attributes of males and females. The influence of gender on learning and achievement has remained a controversial and topical issue amongst educationists and psychologists.

Gender role stereotyping continues to permeate our society and culture; and as it were, determines the extent of progress and achievement in the adolescents' chosen field of endeavor. For adolescent students of chemistry in secondary schools, chemical bonding is a difficult chemistry concept. The question then arises: is students' achievement in chemical bonding a function of the influence of their gender?

A difficult chemistry concept is one which student do not easily understand and teachers do not also find easy to teach. The abstract nature of the concept and the formal approach adopted by teachers in presenting the concept to the students have often been blamed for

the difficulty experienced by students' in understanding and underachievement in this particular concept and the subject of chemistry generally.

Some studies blame school locations for students' underachievement in chemistry, arguing that there is disparity in educational opportunities available to those whose schools are located in rural and urban areas, because of disparity in distribution of educational facilities and material including personnel in favor of urban schools. The content coverage of this study will be on chemical bonding, definition of chemical bonding, materials needed to start chemical bonding, requirements for combination, Lewis symbols and the octet rule, types of chemical bonding, bond polarity and negativity.

For this study, SS 2 students will participate in both controlled and experimental classroom using conventional teaching method for the controlled group in classroom and a projected media for the experimental group. An achievement test on the concept of chemical bonding will be administered on the students who will participate in the study, before and after the application of the teaching method; this is because it is at this level that chemical bonding concepts are introduced to students as the integral part of the syllabus of secondary school chemistry.

1.7 Operational definition of major terms and variables

Effect: this is the ability to bring about results. It can also be seen as an influence or action carried out on learners.

Projected Instructional media (PIM): this encompasses or describes all physical means schemed so as to extend or protrude beyond or planned including printed materials or even all devices an instructor might use to implement instruction and facilitate student's achievement of instructional objectives. This may include computer laboratory, charts,

slides, filmstrips, magnetic boards, blackboard, overhead projectors, transparencies, audio and visual conferences etc.

Achievement: this means an impressive academic accomplishment or attainment especially by superior ability and great courage.

Retention: is the ability to remember fundamental concepts rather than just "facts". It is also defined as having information learned, stored in a long-term memory in such a way that it can be readily retrieved.

Teacher: this is a facilitator for the acquisition of Chemistry knowledge and skills by the students in a formal school setting.

Students: students here mean learners of the last three years of secondary school education in formal schooling of 9-3-4 Nigeria Education programmes.

1.8 Significance of the Study

The study on the use of projected instructional media and enhancement of the knowledge of chemical bonding especially in chemistry will be of great benefit to the following stakeholders of chemistry education in Nigeria: the students, teachers, parents, educational overseers, curriculum planners and future researchers.

The findings of this study will be of assistance to the students in learning and obtaining knowledge and skills in chemical bonding in the study of chemistry. The study may also be of benefit if the application of projected instructional media proved effective, as students' achievement may increase. This is because projected instructional media will incorporate the cognitive, affective and psychomotor facets of learning of chemistry and making teaching and learning attractive, inspirational and effective.

The outcomes of this study will inspire chemistry teachers to make use of projected instructional media in their teaching and learning process to facilitate effective communication. This may accordingly enable chemistry teachers to present chemical bonding concept to their students in a way they will understand, assimilate and retain the knowledge for high achievement. The repercussion is that the success will boost the chemistry teachers' morale.

The conclusions of this study may also sensitize school administration to encourage chemistry teachers to utilize projected instructional media by providing them essential instructional resources for the teaching and learning of chemical bonding.

The results of the study will also be of benefit to chemistry curriculum planners; this is because they will thoroughly plan the curriculum alongside with the needed instructional materials to be used in order to assist students' achievement in chemistry.

The outcomes of this study will be of great benefit for the government, to see the necessity to retrain chemistry teachers on the proper use of projected instructional media. The findings of the study also will serve as a guide for the government to make available the necessary instructional material in the school to help both the teachers and students in the teaching and learning of chemistry.

The conclusions from this study aims at enabling the government and other educational stakeholders put into consideration the role that gender and school location play when planning the curriculum. This will help in effectively providing a curriculum that will favour both male and female students in either urban or rural areas to have access to similar level of knowledge.

The findings of this study may also serve as a fountain of information in library conferences in the institution of learning and for those who may need to carry out research in chemical bonding as well as the utilization of projected instructional media. It is hoped that the results of this study will serve as a basis for further studies in the area of chemistry methodology of teaching in respect to use of projected instructional materials.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter offers an overview of the preceding research carried out on the effects of projected instructional media on the achievement and retention of students on the concept of chemical bonding among secondary school students. In this chapter, an effort is made to closely examine if there is any empirical suggestion to support the assertion that the application of projected instructional media in the classroom improves students' achievement and retention on the concept of chemical bonding. It is important to set the context of the literature review work under the following headings:

2.2 Conceptual Framework

2.2.1. Teaching chemistry in secondary schools in Nigeria

Science is a way of thinking in pursuit of understanding nature (it is a way of investigating a body of established knowledge) Aniodoh (2012). The concept of teaching method is viewed from different perspectives and defined in various ways. There are different methods of teaching and there is no single best approved method of teaching science. A good science teacher should use a variety of approaches and pick any that is appropriate in a given situation considering the varieties or differences in the learners and environment. There are many known and practiced methods which tend to satisfy the objectives of teaching science and these include: -

- The production of much needed manpower e.g. economically and technologically.
- Acquisition of scientific knowledge
- Development of individual potentials
- Acquisition of discovery approach

- The development of rational thought e.g. collating and developing scientific attitude in people.
- Explaining natural phenomena for general scientific literacy

Science and technology if properly maintained and harnessed can no doubt, help to move a nation forward. Therefore, in this era of rapid technological development and advancement, scientific literacy is important for agricultural, medical, economical, industrial development and some that are yet to be discovered. The various methods in which science knowledge is impacted include the following: -

- Expository or traditional lecture method
- Discussion method
- Discovery/inquiry method
- Demonstration method
- Scientific/Laboratory approach/problem solving method
- Project method (Active learning process)
- Simulation and gaming method
- Field trip method
- Information, communication technique

Therefore, if science is defined as the study of the natural world, chemistry being a branch of physical science is concerned with atoms and their exchanges with other atoms and particularly with the properties of chemical bonds. Chemistry focuses on the organized

study of the physical world. As a result of its importance, the subject chemistry, is one of the fundamental subjects in the field of science and mathematics in the senior secondary education structure curriculum in Nigeria.

The study of chemistry is very important as it has a connection to other fields of learning especially in science. The knowledge of the subject and its application has greatly contributed to the industrial enlargement of any nation who takes its study serious. As many as the importance of chemistry is, students encounter difficulties in learning the subject due to the theoretical nature of teaching the subject.

The teaching of chemistry has customarily been based on the conventional teaching method of "talk and chalk", which is largely a teacher–centered approach, where the students learn via note taking and are assessed through their ability to regurgitate facts. One of the professional abilities of a teacher is to find ways of making complex ideas accessible and simplified, but this must be balanced by the need to present learning materials in a way that is scientifically valid and provides a suitable platform for future learning. Studies have shown that the teaching of chemistry concepts in Nigerian secondary schools are quite inappropriate, uninspiring and conventional.

The academic achievements of a student in a particular subject or course are determined by short- or long-term goals acquired. According to Oxford Advance Learners Dictionary, to achieve means "to succeed in reaching a particular set goal, status or standard especially by an effort for a longtime". Achievement in chemistry goes to emphasize the effort or skill put in to gain/acquire or achieve success in chemistry as a science subject.

Academic achievement in electronic libraries refers to "as the ability to retain and subsequently remember things experienced or learned by an individual at a time" (Ugwuanyi, Mwantok, Mbara and (Ogbu, 2018)". Academic achievement is the successful

completion, through effort, of the acquisition of academic content and skills which is determined by the scores or grades that students get in an examination or test (mutual, 2015 cited in Mbonu, 2018).

A lot of factors influencing the teaching and learning of sciences in which chemistry is inclusive have been researched and discussed by various researchers and educational stakeholders. The factors range from instructional materials, teaching strategy, gender disparity, ignorance and attitude of teachers, and student's behavior towards the learning facilities provided etc. Considering the analysis of students' achievements in recent WAEC examination and result, it poses a great concern to the nation that there is a great drop in students' achievement in most science subjects. The continuous use of the lecture method by science teachers which is attributed to the teachers' academic level, contributes about seventy percent of the scientific information received by the pupils. Egbu (2012) argued that involving learners in classroom activities is what matters most as it makes teaching learner centered.

Even with the important position occupied by this subject, it can be easily observed that students' academic achievements in some concepts of chemistry is not encouraging. Poor achievement in learning chemistry concepts can be attributed to many factors such as incapability of teachers to incorporate learner-centered teaching methods, teacher's inability to sustain students' interest during lessons, lack of well-trained ICT teachers and scantiness of laboratory facilities.

One may ask whether the use of projected instructional media can enhance students' achievement in chemistry since e-laboratory method seen above did not show any significant difference between the experimental and control groups. The fact therefore

remains that involving students in practical classes enhances their understanding and retention of what was taught.

2.2.2. Retention as a Factor of Learning

Retention according to Encarta dictionary is defined as the ability to remember things. It is also viewed as keeping or holding something mentally. This is the ability to recall or remember what was learned previously or to store information for long periods. The aim of teaching and learning some concepts in chemistry, making teaching strategy and using resource materials is to establish a behavioral objective and make learning more meaningful, this is the ultimate goal because meaningful learning is a product of retention. Retention occurs when experiences are coded in the memory of the learners. Studies have shown that poor learning and retention in science may be related to the learner's inability to link new knowledge to the previous knowledge and such studies reported that stimulating learning environment, interest, activity-oriented teaching strategies are all that learners need to retain new learned information. The understanding of imagery is of great importance to the learners' retention; therefore, teachers should be encouraged to apply the methods of teaching that will appeal to many senses of the learners.

A multimedia aided instruction engages the students' interest and encourages them to collaborate, to inquire and to explore effectively far beyond the bounds of the school (Galope,2013). Recent studies have shown that people remember 20% of what they see,40% of what they see and hear, but about 75% of what they see and hear and do simultaneously (Khrishnasamy,2016). Learning is complete when knowledge is transferred into a new situation. The need to have diverse practice tools is to facilitate transfer and enhance retention process. Studies on types of learning tools that promote student's retention is yet

to be concluded. For instance, Shieh & Yu (2016) revealed that guided discovery instruction influenced learning and retention.

Development psychologists who adopt the Information processing perspective account for mental development in terms of maturational changes in basic component of a child's mind. The theory is based on the idea that human beings process information received. This equates the mind to a computer which analyses information from the environment. The mind's machinery includes attention mechanism for bringing information in working memory for actively manipulating information and long-term memory for passively holding information so that it can be used in future. Human beings have many memory stores and information is transferred from one store to another. Cognitive processes include perception, recognition, imagining, remembering, thinking, judging, reasoning, problem-solving, conceptualizing, planning and applications. These cognitive processes can emerge from human language, thought, imagery and symbols. One wonders if the application of projected instructional media in the classroom could help the students to perceive, recognize and conceptualize chemical bonding!

2.2.3. Concept of Chemical Bonding and Student's Achievement and Retention.

A chemical bond is an attractive force between atoms that allows the formation of chemical substances that contain two or more atoms. The bond is caused by electrostatic force of attraction between opposite charges either between electrons and nuclei, or as the result of a dipole attraction. The strength of chemical bonds varies; some are strong while others are weak. The examples of strong bonds are covalent, ionic and metallic bonds while examples of weak bonds are Vander Waal forces and hydrogen bonds.

The concept associated with chemical bonding and structures such as covalent bonds, molecules, ions, giant lattices and hydrogen bonds are abstract and complicated. Therefore,

in order to understand these concepts, students must be familiar with mathematical and physics concepts that are associated with the bonding concept such as orbital, electronegativity and polarity. There are two main types of chemical bonding namely: covalent and electrovalent (ionic) bonding; (other types of bonding have been mentioned above). These two types of chemical bonding are stipulated in senior secondary school two (SS2) chemistry curriculum.

The electrons in the valence or outmost shell of atoms determine the chemical behavior of most elements. An example is the atoms of noble gases which have complete or full valence shells. The electronic configuration of a complete outer shell is very stable, so the noble gases usually exist as single atoms and rarely react with other elements. Atoms of other elements attempts to initiate the stable configuration of the noble gases. They do this by donating, accepting or sharing electrons in chemical reactions with atoms of the same element or atoms of other elements.

When atoms donate, accept or share electrons with other atoms to complete their valence shells, they form chemical bonds. The resulting substance is called a compound or molecule. The type of bonding depends on whether the electrons are transferred or shared.

An atom with few electrons in its valence shell will tend to donate these electrons to fill an almost complete shell in another atom this takes place when an electropositive or metallic element combines with electronegative or non-metallic element. Atoms that have an electrical charge are called ions. Ionic bonds have no particular orientation in space since they result from equal electrostatic attraction of each ion to all ions around them. Ionic bonds are strong and require temperature to melt. The bonds are brittle because the forces between ions are short-ranged and do not easily bridge cracks and fractures. It gives a physical character to crystals of sodium chloride. These opposites charged ions attract each other and

an ionic bond is formed between them. Example of ionic bonding occurs in formation of some compounds like sodium chloride, magnesium chloride and calcium oxide.

For example, the reaction between sodium (Na) and chlorine (Cl)

Na • + • Cl: = Na+: Cl: -

Na has lost an electron to become Na+, and chlorine has gained the electron to become Cl -.

Covalent bonding is formed between atoms when the valence electrons of one atom are shared with another atom with no discrete transfer of electrons. For example, two atoms of hydrogen each with single electron can share their electrons. Each hydrogen atom shell is now complete with two electrons. This covalent bonding yields a molecule of hydrogen.

For example

H • + • H = H •• H or H: H

In molecules, each valence electron belongs to the molecule not to the individual atoms. Covalent compounds have low melting and boiling point and can dissolve in organic solvent. When metal atoms combine with each other, the outermost electrons loose contact with their parent atoms. The remaining positively charged atomic Centre's form an ordered structure while the outer electrons move freely around the whole sample. These freely moving electrons called conduction electrons can carry heat energy and electric charge easily throughout the metal, making metals good conductor of heat and electricity.

This type of bonding is often very strong (resulting in the tensile strength of metals) Metallic bonds are more collective in nature than other types and so they allow metal crystals to be more easily deformed because they are composed of atoms attracted to each other but not

in any particularly oriented way. This results in the malleability of metals. The sea of electrons in metallic bonds causes the metals to be good conductors of heat and electricity. It also gives its shiny reflection of most frequencies of white light.

Hydrogen bonding occurs among some components like hydrogen fluoride and water molecules. This is because the valence electrons in the water molecule spend more time around the oxygen atom than the hydrogen atoms, the oxygen end of the molecule develops a partial negative charge (because of the negative charge on the electron). For the same reason, the hydrogen end of the molecule develops a partial positive charge. Ions are not formed; however, the molecules develop a partial electrical charge across it called a dipole. The water dipole, the head of the arrow points toward the electron devise (negative) end of the dipole and the other direction is near electron poor(positive) end of the molecules. (Wikipedia encyclopedia).

The concept of chemical bonding is abstract and students lack deep conceptual understanding and fail to integrate their mental models into a coherent conceptual frame work. Taber (2011). According to the authors, the traditional approach being used alone in teaching chemical bonding is inadequate and ineffective. This therefore brings about the question "if the application of projected instructional media when used with lecture method effectively improve students' achievement and retention in chemical bonding.

2.2.4. Concept of projected instructional media and its relevance to the teaching and learning of chemical bonding.

Instructional media serve as a channel between the teachers and the students in delivering instructions. It is used to get the attention of the students and eliminate boredom. They are also seen as devices or pieces of equipment, graphics or sound representation or illustration

that helps students to learn. The four types of instructional aids can be classified into the following categories:

1. **Visual Aids: -** These include chalk board, posters, bulletin board, displayed models, motion pictures, slides, projected transparences, Flip chart and flannel boards. In fact, they represent all the materials the eyes can focus on and is used by the teacher or instructor in delivering the lesson to the students, it makes visual impression.

2. **Auditory Aids**: - These include record players, tape recorders and language laboratory and all that appeals to the sense of hearing.

3. **Audio-visual Aids: -** These include aids that make use of both sight and hearing such as sound motion, pictures, slide on sound and television.

4. **Simulation Devices: -** These include devices built to stimulate the action or function of the real thing. The essence of this type of aid is to develop feeling sensation and correct habits.

Any subject can be taught more effectively through the appropriate use of teaching materials or aids, because a good instructional media possesses some necessary qualities such as:

- it appeals to all the senses
- it focuses attention on the essential elements to be learned at the proper time
- it stimulates the interest of the learners.

The term “projected instructional media” is not a universal language but it refers to relevant materials which when used effectively either in a formal or informal classroom situation to transfer ideas from the teacher to the students makes learning usually easy and well

understood, this is because they are closely related to the way people do things in their everyday life. They can be seen as those channels of communication which promote the effectiveness of instruction and help the teacher to communicate ideas effectively to the students; Njoku and Ali, (2012). These media are alternative channels of communication which a teacher can use to concretize an abstract concept during teaching. According to Fidanboylu (2014), the use of visual aids during teaching, motivates the students and reinforces the learned language. It further improves reading, writing, speaking and listening skills which leads a better academic performance of learners. Kwesiga (2013) stated that a student academic performance is a function of the number of instructional mediums the school offers, which in turn affect their academic performance.

A reasonable conclusion then is that the importance of instructional materials in teaching and learning science is most efficient illustrated through student achievement result. It is against this fact that this research work was carried out to determine the effect of projected instructional media on the academic performance and retention of the secondary school students in the concept of chemical bonding in Bosso Local Government Area of Niger State.

2.2.5. Gender and its relevance to students' achievement and retention in learning Chemical bonding.

Gender issue is a contemporary one that attracts attention of psychologists, sociologist, educationist, scientists and even parents. Gender could be seen as a factor which indicates whether a human being is a male or female. "Gender simply means the character or characteristics of being male or female, man or woman, boy or girl (male or female students)" (Ukala, 2018). Ndanwu (2020) 0bserved a significant difference between male and female's academic achievement and interest in electronic libraries in favour of the girls.

Thus, Halpern and Diane (2011) cited in Elejere and Eze (2018) found that science is free from gender bias.

Oluwatosin and Ogbeba (2017) study on impact of gender on senior secondary chemistry student's academic achievement in stoichiometry using hands-on activities discovered insignificant difference in average achievement scores between male and female students who were taught stoichiometry. The study also found that there was a significant relationship between the technique and gender of average achievement scores of learners. Also, the results from a study by Fatokun and Omenesa (2015) revealed insignificant variation in both genders differences and academic achievement despite the fact that girls were not as active as boys in the classroom interaction during teaching and learning. Implying, that students can achieve high academic scores irrespective of their gender.

The physical character of an individual may not be expressed psychologically or emotionally. For instance, careers or subject that are feminine in nature such as catering, is practiced by boys while girls are studying engineering and carpentry meant for boys previously.

A lot of research has been carried out on gender and paper presentations to create awareness on gender equality and disparity. This low participation of female students in science related subjects were attribute to factors such as: - attitude of teachers, students and parents to the idea of women engaging in male career such as Engineering, Technology, Architecture etc.

Akintade (2017) examined the collaborative effects of gender and teaching methods on students' academic achievement and attitude towards longitude and latitude in Nigerian. He discovered that there was no interaction effect related to treatment, gender and student's subject area in the post test. The study of Umoru and Adekunle (2019) revealed that the interaction effects of gender and teaching methods was not significant on student's

achievement and retention in business studies. This showed that gender and teaching method did not significantly interact over the student's achievement.

The girls themselves feel discouraged by the attitudes of teachers and parents and often suffer from low self-esteem. Research findings have shown that female students have less positive attitude towards chemistry than the male and also demonstrated less superiority at secondary school level. This probably ought to be the result of stereo-typing of task that takes place with more attention given to the training and instructing of male population in science-oriented courses. Studies have recognized discrepancies in the learning of boys and girls and the breaches associated to the society of which gender strategies are disseminated through information education in the home and society as a whole. The traditional idea that girls belong to the home and they are to be trained for domestic activities, marriage and motherhood while the boys are to look outside for more challenging situation is not completely eradicated from the society despite advancement in literacy. This ideology is an obstruction to progress and development in science and technology accredited this low number of girls and women to gender stereotyping by the society.

In spite of the fact that certain measures have been taken to bridge the gap between boys and girls, gender inequality is still a preventive factor to the achievement of anticipated learning outcome and developments in science enrolment, achievements and results in unequal access to education, health and employment.

From the above studies it would be safe to state that gender as an influencing factor in the learning, achievement and retention in respect to certain aspects of chemistry, remains important but controversial. None of the reviewed studies was on chemical bonding; this leaves a gap in knowledge, thus creating a need for this present study. The study tends to

investigate the effect of projected instructional media on academic achievements of students in the teaching and learning of chemical bonding especially on gender.

A lot of efforts have been made by various educational groups and institutions to see that science is promoted and enhanced. Researchers have been investigating on effective and efficient ways of impacting science meaningfully.

Gender issue has been of great concern to the various classes in life ranging from school, state and different countries. Gender has created a lot of eye opening that it is being considered at both national and global levels. Gender disparity has been the matter on ground that UN director for women, Michelle Benchlet visited Nigeria to discuss gender issues on women involvement in government (Mirror Newspaper of 15/1/2013) the intimidation of girls in school from the findings of most studies have been over taken by encouraging girls to study subjects they are good at especially sciences irrespective of their status. This will enable them contribute more to national development. This has led to the advocacy of women for change peace mission "initiative" of Nigerians (office of first lady of Nigeria). They see women as being in the forefront of the nation. According to Dame Patience Jonathan, "Empowering them means empowering the nation". It goes in line with, "to educate a girl is to educate a nation". The implication of all the issues discussed implies that chemistry as a subject should be taught with the use of instructional materials, using fruitful teaching strategies and giving equal treatment to both male and females; in short gender disparity and inequality should be discouraged. Meaning full learning, egalitarian society and national development in all ramifications of life should be encouraged. The use of projected instructional media makes learning meaningful and enhances retention.

The students' achievement in sciences which includes chemistry had been shown to be poor and, in some cases, fluctuating over the years. These poor achievements of the students

among other factors have been blamed on teaching methods mostly used by the chemistry teachers. These poor results, created the need to look for an alternative method. Thus, the need to further investigate the effect of projected instructional media on students‟ achievement and retention in chemical bonding.

2.3. Theoretical Framework

2.3.1. Information Processing Theory (IPT).

Psychologists in respect to human development who adopt the Information processing perspective account for mental development in terms of maturational changes in basic factors of a child's mind. The theory is built on the idea that human beings process every information received. This compares the mind to a computer which analyses information from the environment. The mind's machinery includes attention mechanism for bringing information into working memory for actively manipulating information and long-term memory for inertly holding information so that it can be used in the future. Human beings have many memory stores and information is transferred from one store to another. Cognitive processes include perception, recognition, imagining, remembering, thinking, judging, reasoning, problem-solving, intellectualizing, planning and applications. These cognitive processes can develop from human language, thought, imagery and symbols. This then makes one to wonder whether the use of projected instructional media could help the students to perceive, recognize and intellectualize chemical bonding?

There are Four Pillars of Information Processing Model are as stated below:

a. Thinking: This involves activities of perception of external stimuli, encoding the same and storing the data so perceived and encoded in one's mental recesses.

b. Analysis of Stimuli: This is the process by which encoded stimuli are reformed to suit the brains recognition and interpretation processes to enable decision making. There are four distinct sub-processes namely encoding, strategization, generality and automatization.
c. Situational Modification: It is when an individual uses his knowledge to handle a similar situation in the future.
d. Obstacle Evaluation: At this stage, there is need for intellectual, problems-solving and cognitive insight of the individual to be checked but the nature of the obstacle or problem also need to be evaluated.

Therefore, it is necessary to discover if the use of projected instructional media could help to modify encoded stimuli in order to suit cognition which can lead to decision making? Could the use of projected instructional media help to overcome obstacles and the experience gained in the classroom and can it be used to handle future problems? The structure of the information-processing system has three major components; namely: Sensory register, short-term memory and long-term memory. The sensory system store, holds unto the sensory information long enough so that unconscious process may operate on these traces to determine whether the input should be brought into the working memory or be rejected. Short term memory is to be the focus of conscious thought, corresponding to the central processing unit of a computer where information from long-term memory and the environment is combined to help solve problems. The short-term memory has a small capacity and cannot attend to much information at a time. Long term memory is the stored representation of all that a person knows. The item stored in long term memory lies dormant until they are called back into the working memory and put to use. (Retrieved from Wikipedia encyclopedia). Could the use of projected instructional media help the students understand the concept of chemical bonding, store and retrieve it when needed?

2.3.2. Dual Coding Theory by Paivio

Paivio (1971) introduced Dual Coding Theory (DCT) of memory and cognition in his published book, imagery and verbal processes. He proposed that DCT evolved from his specific experiments on the role of imagery in associative learning. Dual Coding is within the sphere of the field of psychology. Dual Coding, a theory of cognition was first advanced by Allan Paivio of the University of Western Ontano. The theory postulates, that both visual and verbal information are processed differently and along distinct channels with the human mind creating separate illustrations for information processed in each channel. Both visual and verbal codes for representing information are used to establish incoming information into knowledge that can be acted upon, stored and retrieved for subsequent use.

Lawrence (1995) examined the possibility of using Paivio‟s (1971), Clark and Paivio, 1991) dual coding theory as an explanation for the effects of multimedia on learning. The study defined dual coding theory and also observed the appropriateness of dual coding theory as an explanation of the results of a large number of studies using multiple media. It was observed that individuals tend to learn better when related information is presented concurrently through verbal and pictorial media than when the information is presented via verbal or pictorial media alone. One channel processes verbal information such as text or audio. The representations of information processed by this system are known as logogens. The other channel processes nonverbal images such as illustrations and sound in the environment. The representations of information processed by this system are known as imagens. Both kinds of representational units are concrete modality – specific (visual versus auditory versus sensory motor) analogs rather than abstract, model structures.

According to Paivio (1971), mental images are analogue codes, while the verbal representations of words are symbolic codes. Analogue codes represent the physical stimuli

observed in our environment, such as trees and rivers. These codes are a form of knowledge representation that retains the main perceptual features of what is being observed. Symbolic codes, on the other hand, are forms of knowledge representation chosen to represent something arbitrarily, as opposed to perceptual.

Principal theoretical support for the use of animation, as well as still illustration, and their effects on learning comes from the dual-coding theory (Paivio 1971 and 1986). According to this theory, information is processed and represented by two separate codes known as verbal codes and non-verbal codes. The theory proposed that humans understand the world around them through language and non-verbal objects and occurrences. Paul, Ayres and Amina, (2007) investigated the cognitive learning theory prediction that the unpredictable findings concerning the effectiveness of instructional animations are exacerbated by their transitory nature. Three groups were compared who acknowledged different but equivalent forms of instruction in learning topics in economics. One group acknowledged an animation presentation with integrated text and diagrams, a second group received a static diagram presentation with integrated text and diagrams in a classical split-attention design. Results indicated that the animated design was superior to the static integrated design only on test questions that closely resembled the presented information.

2.3.3. Jerome Bruner's Theory of Learning.

One of the founding fathers of constructivism in person of Jerome Bruner. According to Gamaliel and Cherry (2004), Constructivism is an epistemology of learning based on the fact that reflection on experiences while constructing our own understanding of the world allows learners to formulate a more concrete meaning of subject matter. Constructivism deals with the cognitive processes in which the learner advances his or her knowledge. The major theme of the research is that learning is an active process in which learners construct

new ideas based on their current or past knowledge. The learner selects and transforms information, constructs hypotheses and makes decisions based on the cognitive structure. Cognitive structure (i.e. schemata or mental model) provide meaning and organization to experiences and allows the individual to go beyond the information given. Opportunities are provided for learners to construct new knowledge and new meaning from authentic experiences. Could the use of projected instructional media help students to construct new knowledge that could led to understanding of chemical bonding.

Gamaliel and Cherry (2004) stated that Bruner developed three stages of representation, namely enactive, iconic and symbolic. None of the stages are age specific to the learner compared to Piaget's research which has a specific age for each intellectual stage. In the Enactive stage, knowledge is basically in the form of motor responses. Students may be able to perform a physical task better than describing the exact same task that has just been accomplished. This shows that the learner is more in the enactive stage of representation. In the iconic stage, knowledge is basically more in visual images. When presented with new information, it is sometimes more supportive for people who are in the iconic stage of representation to have a diagram in order to visualize concepts being taught. When in the symbolic stage, knowledge is typically in the form of arbitrary words, mathematical symbols and other systems. The symbol X which stands for multiplication sign in mathematics but can have different meanings in other disciplines such as language.

Otuka and Uzoechi (2009), based on Bruner's theory proposed that the duty of the instructor is to decode information to be learned into a format appropriate to the learner current state of understanding. Curriculum should be organized in a spiral manner so that the student continually builds upon what they have already learned.

Bruner's theory is applicable to chemical bonding using animation instruction strategy. The animated lesson should be prepared to suit the learners current state of understanding and in a way that the learner can easily grasp the concept. Could the use of projected instructional media make the concept of chemical bonding to be grasped easily because the movement of electrons can be seen through the visual display instead of using conventional method which makes the concepts to be abstract to the learner?

2.3.4. Vygotsky's theory of social cognitive Development

Vygotsky's (1972) theory is based on the main theme that social interaction plays a fundamental role in the development of cognitions. An important concept in Vygotsky's theory is that, the potential for cognitive development is limited to a certain time span which he calls the zone of proximal development". Vygotsky describes the zone of proximal development as having four learning stages. These stages ranges between the lower limit of what the student recognizes and the upper limits of what the student has the potential of accomplishing. The stages can be further fragmented as follows:

stage I – assistance provided by more capable hands (coaches, experts, teachers).

Stage 2 - assistance by self.

Stage 3 – internalization, automatization, fossilization and

Stage 4 - de-automatization, reclusiveness through prior stages.

Vygotsky's theory stated that instruction is most effective when learners engage in activities within a supportive learning environment and when they receive appropriate guidance that is mediated by tools (Vygotsky's, 1972). These instructional tools can be defined as cognitive strategies, a mentor, computers and provide information for the learner. The role

of the tool is to establish dynamic support to help (learners) complete a task near the upper end of their zone of proximal development (ZPD) and them to systematically withdraw this support as the (learner) moves to higher levels of confidence. According of Otuka and Uzoechi (2009), the following principles should be kept in mind;

(i) Full cognitive development in the learner requires social interaction.

(ii) Cognitive development in the learner is limited to a certain range at any given age.

However, Hausfather (1996) observed that tradionally, schools have not promoted environment in which the students play an active role in their own education Vygotsky's theory nevertheless requires the teacher and students to play untraditional roles as they collaborate with each other instead of a teacher dictating learning of concepts for students to recite, the teacher collaborate with his students in order to create a meaningful understanding of the concepts. In this way, learning becomes a reciprocal experience for the students and the teacher.

Computer technology is a cultural tool that students can use to mediate and internalize their learning. The use of projected instructional media involves both the teacher and students in the learning process and makes learning to be reciprocal according to the Vygotsky's theory. The theory also observed that instruction is most efficient when students engage in activities within a supportive learning environment and when they receive suitable guidance that is mediated by tools like computers, mentor, printed materials or any instrument that organizes and provide information for the learner.

2.4 Empirical Studies on ICT in relation with Teaching and Learning Chemical Bonding

Dugurgil and Dugurgil (2006) examined the state of the availability and level of ICT use as a resource in science, technology and mathematics (STM) instruction. They used one hundred and seventy (170) STM teachers drawn from twenty secondary schools in five local Government Areas in Plateau Central Senatorial District as subjects. The subjects responded to a twenty-six (26) item questionnaires on their level of awareness, availability and utilization of ICT as a resource in STM instruction. The study revealed that most of the STM teachers are not aware of some ICT resources such as computer software packages and internet facilities. It also shows that most recent ICT resource facilities are lacking in the secondary schools. Another finding is that most of the STM teachers are not computer literate, the very few that are computer literate acquired such skills only through personal efforts, some recommendations were made based on the findings of the study. This study may help the teachers to rise to the challenge of the digital age in which we are live in.

Ajagun (2003) stated that the use of ICT as a resource in teaching and learning of STM can facilitate:

- The acquisition of the basic STM skills by concentration on complex real world task.
- The acquisition of higher order thinking skill and problem solving skills.
- Enable learners access a wider range of information resource/source for developing appropriate STM concepts and relationships.
- Provide learners with a medium of further learning.

Busari (2003), and Iroha and Ekweme (2003) observed that there is a low level of ICT awareness in most secondary institutions in Nigeria. Okuneye (2003) and Rafiu and Dansu (2006) delved into the literacy level of secondary school physical education teachers on computer and internet technologies, and the extent to which they apply the knowledge and skills to the teaching of physical education, eighty-seven (87) physical education teachers participated in the study and self developed analyses were carried out using percentage,

weighed mean score and chi- square. Their findings revealed that the teachers have access to computer and internet, their literacy level is very low and this has resulted to low level of utilization of the technologies for teaching physical education. Okuneye (2003) and Rafiu and Dansu (2006) also recommended that computer and internet education should be intensified for physical education teachers in training and workshop should be organized for teachers in service in order to facilitate their literacy levels in computer and internet.

It is generally assumed that students will understand what they see very easily than listening to abstract ideas presented to them in words. It is said that one does not learn much except if he pays attention and shows an interest in the subject matter. This cannot be easily effectively achieved unless something vital that can captivate the expected interest is presented to the learners as aids. With multimedia, the communication of information can be done in a more effective manner and it can be an effective instrumental medium for delivering information. According to Chapman (2013), the use of multimedia in teaching and learning processes has the potential to improve the learning environment that allows students to take charge of their own learning.

The modern and latest instructional aid in this 21st century is the use of instructional technology media such as making use of computer, television, projectors etc. which gives access to other work and easy development. Okpala, (2010) reported that government indicated that efforts could be made in providing some educational services such as counselling and educational resource centers amongst others and also maintain that teaching should be practical, explorative and experimental in nature. Murphy, (2012) expressed that assessing education means that teachers have to use ICT resources (such as television, projectors) to appeal to the interest of the younger learners and attract their interest.

Chemistry which is a science subject has been inculcated into the school curriculum as a core subject for both male and female students. Poor achievements of students in the sciences

were attributed to certain factors like lack of facilities and negative attitude of teachers to the use of instructional materials. Recently emphasis is laid on the use of projected instructional media to enhance meaningful teaching and learning. Teachers are encouraged to develop positive attitude towards making use of instructional materials available and also improvise where necessary to enhance learning in chemistry. NTI Kaduna through (SMASE) workshop encourages the training of some teachers from different states in Nigeria in promoting the teaching of science through project, inquiring and adequate teaching strategies. As a matter of urgency and for development, the last couple of decades have undergone tremendous changes in the development of science and technology which has as its grass root science subjects such as chemistry and others. Science teachers have been searching for effective instructional strategies, materials that would enhance the teaching and learning of chemistry and science to the young ones. Information and Communication Technology (ICT) innovations have been a welcome device to the needs of the younger generation in terms of curriculum, materials and strategies. This suggests that mastery of chemistry concepts cannot be fully achieved without the use of instructional materials. The teaching of chemistry without instructional materials will certainly result to poor performance in the course. It can never be overemphasized that professionally qualified science teachers, no matter how well trained would be unable to put ideas into practice if the school environment lacks the equipment and materials needed in interpreting skills into reality.

Experience over the years has shown that teachers have been depending on excessive use of words to express and convey ideas or facts in the teaching-learning process. This process is termed the ‘chalk-talk ‘method. According to Soetan (2010), graphics including charts, posters, sketches, cartoons, graphs and drawings. Graphics communicate facts and ideas clearly through combination of drawings, words and pictures. The use of graphics in

teaching creates definitiveness to the materials being studied. They help to visualize the whole concepts learned and their relationships with one another. Hands-on instructional materials show, rather than tell, which increase information retention. A truism often heard in teaching is that “if you have not learnt, I have not taught”.

Some studies carried out to investigate on the relationship between instructional media and students’ performance as reported in literature included that of Apondi, (2015) and , Okonkwo, (2016) who discovered that student taught with instructional media performed better than those taught with traditional approach and that gender does not significantly affect the understanding of the students when taught with instructional media method it also showed that the use of instructional media in teaching influences the performances of chemistry students positively in the same vein, Abdu-Raheem (2016) also discovered that students who were taught with instructional media performed better than those taught without instructional media and there was no gender effect. Euhuean (2015) stated that the use of instructional media method in teaching significantly improve student’s performance an recommended the use of instructional media in teaching mathematics and other areas of science.

Onyenho and Harbo Peters (2003) recommended among other things that teachers should continuously use computer in teaching mathematic as it is likely to guarantee improvement in students‟ achievement in mathematics and that gender has proved not to be a barrier for teachers‟ awareness on the uses of computer in a mathematic classroom.Etukudo (2003) studied the level of application of computer in the teaching and learning of mathematic in Nigeria secondary schools and the possibility of effective use of computer in teaching and learning mathematic in secondary schools in Nigeria. A stratified random sampling of six hundred (600) secondary schools from three states of the south-south zone of the country namely Akwa Ibom, Rivers, Bayelsa was used for the study. He used a total of 6000 students

and 1800 mathematic teachers who responded to the questionnaire. The study revealed that computer has not been used at all in teaching mathematic in secondary schools and that majority of the students have no knowledge of computer.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter of the research deals with the research design, population of the study, sample and sampling techniques, research instruments, validation of research instruments, reliability of research instruments, learning materials and lesson plans, method of data collection and method of data analysis respectively.

3.2 Research Design

The quasi-experimental research design was adopted for this study. This research design is majorly accepted when there is non-randomization of research subjects and it precisely involves, the pre-test, post-test and non-equivalent control group design. This design was used because it was not possible for the researcher to randomly sample the subjects and allocate them to groups without unsettling the academical programmes of the schools involved in the study. Two groups of respondents were used on the study, (male and females). The "experimental groups were taught with the use of a projection media identified for this study. While students in the control group were taught using lecture method. The researcher therefore, randomly assigned intact classes of two schools to experimental (E) group and intact classes of another school to control (C) group. This did not disrupt the school time table and lessons.

3.3 Population of the study

The study was carried out in Bosso Local Government Area of Niger state, Minna. Where the occupation of most of the people are predominantly farming and trading. The population for the study comprised of all the senior secondary two (SS2) chemistry students in the 20 schools in Bosso Local Government Area of Niger state. The population of science students as at 2018/2019 academic session was ten thousand two hundred and four (10,204). The data was obtained from the Niger state ministry of Education.

3.4 Sample and sampling techniques

The sample size comprised of eighty (80) SS2 chemistry students (50 males and 30 females) drawn from two schools out of the 20 public co-educational secondary schools in the study area. The reason for choosing this category of schools is to enable the researcher to compare the abilities of boys and girls in chemistry conceptual skills, in relation to the gender effect of projected instructional media on the achievement and retention of the students. The two schools were randomly selected because they are both mixed schools (made up of both male and female students) with enough population of both genders. The reason for the researcher's choice of these two schools is due to their diverse economic and socio-economic backgrounds e.g. children of military parents, business class, farmers, and civil servants and also the children are from different parental care and background. One school was assigned as the experimental group (E) and the other was assigned the control group(C). The same subject content was taught in all the intact classes for the purpose of uniformity.

3.5 Research Instruments

Two instruments were utilized for this research study, namely:

i) Treatment -power point package(slides) and

ii) The Chemistry Achievement Test (CAT) that was used for evaluating the students' retention level and knowledge in the concept of chemical bonding.

The researcher developed the chemistry achievement test which was made up of twenty multiple choice questions as related to chemical bonding. The table of specification was used as a guide to develop a specific number of multiple-choice test items to cover the various levels of Blooms taxonomy of cognitive objectives. The test blue print reflected the four different sub-topics covered on chemical bonding namely: ionic bonding, covalent bonding, hydrogen bonding and other binding forces.

The CAT contains twenty multiple choice objective questions based on chemical bonding. There are four response options A, B, C and D in the instrument. The answers were distributed among the alphabets to make sure that the answers do not have the same letters and this was done in both the pre-test and post-test.

The instrument (pre-test) was first administered to the whole research subjects preceding the treatment, the students were required to choose the correct answers from the questions. In every question, only one option was correct while other options were wrong. The correct option was scored two marks while the wrong option was scored zero mark. The total mark score was 40 while the least mark score is 0. The options were drawn from the chemistry curriculum and past questions while the objectives as specified in the National Curriculum in Chemistry was used to guide the number of higher order and lower order cognitive questions. Thereafter, the items in the pre-test were reorganized to make them appear different. The reorganized post-test was then administered to all the subjects at the end of the treatment so as to measure the retention level of the students.

3.6 Validity of the instruments

The instruments were exposed to both content and face validation in order to evaluate the psychometric properties of the instruments. The instrument was given to an expert science educator from the department of chemistry Education in Niger State College of Education, Minna Niger State, for both face and content validation where it was critically scrutinized and examined for the suitability and relevance of the items, the clarity and appropriateness of language, among other things. The observations made, helped to readjust some questions that was not properly framed, ambiguity and eliminate inadequate test items in relation to the research questions, hypotheses, and purpose of the study. These questions consequently formed the CAT used in the study.

3.7 Reliability of Research Instruments

The researcher ascertained the reliability of the instrument by using a test re-test method. As test-retest method demands, chemistry achievement test was administered to forty SS2 chemistry students of Government Day Senior Secondary School and also forty of the same tests was administered to chemistry students of Ahmadu Bahago Secondary School, Bosso Minna as pre-test.

The reliability of the instrument was determined was determined by giving 40 SS2 students from Government Day Secondary School, one of the selected schools a trial test and the result gotten was used to determine the reliability of the instruments. Kudder Richardson formula 20 (K-R 20) was used to calculate the internal consistency of the Chemistry Achievement Test. The reliability estimate of the Chemistry Achievement Test was calculated to be 0.77. Therefore, the Chemistry Achievement Test was considered to be reliable enough for data collection in this study.

3.8 Method of Data Collection

The data was collected by the researcher using pre-test and post-test. Where forty (40) copies of the pre-Chemistry Achievement Test was personally administered by the researcher to the respondents of two schools (after getting permission and clearance from the principal of the two schools to be involved in the study) before treatment. The researcher then used one week in teaching the students on the basic types of chemical bonding in details and the use of projected instructional media was used in the school for experimental group. All the respondents were expected to give maximum cooperation; Hence, enough time was taken to explain how to tick their answers. At the end of the treatment session, the post-

CAT was administered to the subjects. One week after the post-CAT was administered to the subjects, the post-CAT was again administered as ‘retention test’. The data collected from the subjects were analyzed to answer research questions and test the research hypotheses.

3.9 Method of Data Analysis

The data generated from the study were analyzed using various statistics. The research questions were answered using mean, standard deviation, t-test statistics of test scores to analyze the pretest and post test scores. The hypotheses were tested at 0.05% level of significance using statistical package for social science (SPSS) version 25.

CHAPTER FOUR

4.0 PRESENTATION AND ANALYSIS OF DATA

4.1 Introduction

This chapter deals with the presentation, discussion and analysis of collected data on the "effect of projected instructional media on secondary school student's achievement and retention in chemistry in Bosso Local Government Minna, Niger State". The purpose of this research is to determine the effect of projected instructional media on students' academic achievement and retention on the "concept of chemical bonding".

4.2 Analysis of Research Questions

Research Question 1: What is the academic mean achievement of the senior secondary school students taught concept of chemical bonding with projected instructional media and those taught using conventional method of teaching in the selected schools in Bosso area council of Niger state?

***Table 2.3*: Students Achievement Mean Scores and Standard Deviation Scores in chemical bonding.**

Groups	N	Pre-Test Mean	Pre-Test S. D	Post-Test Mean	Post-Test S. D	Mean Gain
Experiment	40	10.35	3.92	26.40	6.11	16.05
Control	40	12.10	4.17	18.58	6.48	6.48

The table 2.3 above shows that the mean gain of senior secondary school students taught concept of chemical bonding with projected instructional media (16.05) was greater than the mean gain of secondary school students taught using conventional method (6.48). The analysis indicates that the Mean of Post-Test Scores of students taught concept of chemical bonding with projected instructional media (26.40) was greater than the mean gain of secondary school students taught using conventional method (18.58). This implies that the secondary school students who were taught concept of chemical bonding with projected instructional media performed better that those taught using Conventional Method of teaching.

Research Question 2: What is the academic mean retention of the senior secondary school students taught concept of chemical bonding with projected instructional media and those taught using conventional method of teaching in the selected schools in Bosso area council of Niger state?

***Table* 2.4: The table shows the academic mean and standard deviation of the retention in chemical bonding.**

Groups	N	Post-Test Mean	Post-Test S. D	Retentive Mean	Retentive S. D	Mean Gain
Treatment	40	26.40	6.11	24.50	5.57	1.90
Control	40	18.58	6.48	20.45	6.08	1.87

The table 2.4 above shows that the mean gain of senior secondary school students taught concept of chemical bonding with projected instructional media (1.90) was greater than the mean gain of secondary school students taught using conventional method (1.87). The analysis indicates that the Mean of Post-Test Scores of students taught concept of chemical bonding with projected instructional media (24.50) was greater than the mean gain of secondary school students taught using conventional method (20.45). This implies that the secondary school students who were taught concept of chemical bonding with projected

instructional media possessed high retention ability than those taught using Conventional Method of teaching.

Research Question 3: What is the academic mean achievement of the senior secondary school students with respect to gender, taught concept of chemical bonding with projected instructional media method of teaching in the selected schools in Bosso area council of Niger state?

Table 2.5: **Academic Achievement Mean and Standard Deviation with respect to gender in chemical bonding using projected instructional media method of teaching**.

Groups	N	Pre-Test Mean	Pre-Test S. D	Post-Test Mean	Post-Test S. D	Mean Gain
Males	15	9.60	4.04	26.72	6.68	17.12
Females	25	11.60	3.48	25.87	5.21	14.27

The table 2.5 above shows that the mean gain of male and female senior secondary school students taught concept of chemical bonding with projected instructional media (17.12) was greater than the mean gain of female secondary school students taught (14.27). The analysis indicates that the Mean of Post-Test Scores of male students taught concept of chemical bonding with projected instructional media (26.72) was greater than the mean gain of female secondary school students taught (25.87). This implies that the male secondary school students which are taught concept of chemical bonding with projected instructional media performed better that the female students. Moreover, the variation of the mean gain values indicates that the teaching of the concept of chemical bonding with projected instructional media is effective and applicable for both genders.

Research Question 4: What is the academic mean retention of the senior secondary school students with respect to gender taught concept of chemical bonding with projected instructional media method of teaching in the selected schools in Bosso area council of Niger state?

***Table* 2.6: Academic mean and standard deviation on retention with respect to gender with students taught chemical bonding with projected instructional media.**

Groups	N	Post-Test Mean	Pre-Test S. D	Retention Mean	Retention S. D	Mean Gain
Males	15	26.72	6.68	24.16	6.17	2.56
Females	25	25.87	5.21	25.07	4.62	0.80

The table 2.6 above shows that the mean gain of the retention of male and female senior secondary school students taught concept of chemical bonding with projected instructional media (2.56) was greater than the mean gain of female secondary school students taught (0.80). The analysis indicates that the Mean of Post-Test Scores of male students taught concept of chemical bonding with projected instructional media (24.16) was greater than the mean gain of female secondary school students taught (25.07). This implies that the male secondary school students which are taught concept of chemical bonding with projected instructional media possessed high retention ability that the female students. Moreover, the variation of the mean gain values indicates that the teaching of the concept of chemical bonding with projected instructional media is effective and applicable for both genders.

4.3 Analysis of Null Hypothesis

Hypothesis 1

H_{01}: There is no significant difference in the mean pre-test and post test scores in academic achievements of students taught concept of chemical bonding using projected instructional media

Table 3.1: Sample T-test of Pre-Test and Post-Test Scores of students taught concept of chemical bonding using projected instructional media

Sample T- Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Projected Instructional Media Method (Pre-Test)	16.701	39	.000	10.35000	9.0965	11.6035
Projected Instructional Media Method (Post Test)	27.312	39	.000	26.40000	24.4448	28.3552

The Table 3.1 above shows that Sig. value (0.000) which does not exceed 0.05 level of significance. There we fail to accept the null hypothesis and conclude that there is significant difference in the mean pre-test and post test scores of academic achievements of students taught concept of chemical bonding using projected instructional media.

Hypothesis 2

H_{02}: There is no significant difference in the mean pre-test and post test scores of academic achievements of students taught concept of chemical bonding using Conventional Method.

Table 3.2: Sample T-test of Pre-Test and Post-Test Scores of students taught concept of chemical bonding using conventional method

Sample T- Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Conventional Method (Pre-Test)	18.332	39	.000	12.10000	10.7650	13.4350
Conventional Method (Post Test)	18.140	39	.000	18.57500	16.5038	20.6462

The Table 3.2 above shows that Sig. value (0.000) which does not exceed 0.05 level of significance. There we fail to accept the null hypothesis and conclude that there is significant difference in the mean pre-test and post test scores of academic achievements of students taught concept of chemical bonding using conventional method.

Hypothesis 3

H_{03}: There is no significant difference on the academic retention of male and female students taught concept of chemical bonding using projected instructional media and that of the female students.

Table 3.3: Sample T-test of mean retentiveness score of male and female students taught concept of chemical bonding using projected instructional media

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Retentiveness (Male)	19.582	24	.000	24.16000	21.6136	26.7064
Retentiveness (Female)	21.010	14	.000	25.06667	22.5077	27.6256

The Table 3.3 above shows that Sig. value (0.000) which does not exceed 0.05 level of significance. There we fail to accept the null hypothesis and conclude that there is significant difference on the academic retention of male students taught concept of chemical bonding using projected instructional media and that of the female students.

4.4 Discussion of Findings

The first research question that sought to determine the academic mean achievement of the senior secondary school students taught concept of chemical bonding with projected instructional media and those taught using conventional method of teaching in the selected schools in Bosso area council of Niger state was answered from table 1 and 2. The table revealed that that the mean gain of senior secondary school students taught concept of chemical bonding with projected instructional media (16.05) was greater than the mean gain of secondary school students taught using conventional method (6.48). The analysis indicates that the Mean of Post-Test Scores of students taught concept of chemical bonding with projected instructional media (26.40) was greater than the mean gain of secondary school students taught using conventional method (18.58). Moreover, the hypothesis finding in Table 7 shows that the Significant value (0.000) which does not exceed 0.05 level of

significance. There we fail to accept the null hypothesis and conclude that there is significant difference on the academic achievement of students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

The Second research question was answered from table 2 and 3. The table shows that the mean gain of senior secondary school students taught concept of chemical bonding with projected instructional media (1.90) was greater than the mean gain of secondary school students taught using conventional method (1.87). The analysis indicates that the Mean of Post-Test Scores of students taught concept of chemical bonding with projected instructional media (24.50) was greater than the mean gain of secondary school students taught using conventional method (20.45). Moreover, the findings from the stated hypothesis in Table 8 shows that the Significant value 0.000 which does not exceed 0.05 level of significance which goes in line with Lawrence (1995) who proposed that individuals tend to learn better when information is presented through the use of both pictorial or verbal media, which is in line with dual coding theory by Paivio (1971). There we fail to accept the null hypothesis and conclude that there is significant difference on the academic retention of students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

The third research question that sought to ascertain the academic mean achievement of the senior secondary school students with respect to gender taught concept of chemical bonding with projected instructional media method of teaching in the selected schools in Bosso area council of Niger state was answered in table 4 and 5. The table revealed that the mean gain of male senior secondary school students taught concept of chemical bonding with projected instructional media (17.12) was greater than the mean gain of female secondary school students taught (14.27). The analysis indicates that the Mean of Post-Test Scores of male students taught concept of chemical bonding with projected instructional media (26.72) was

greater than the mean gain of female secondary school students taught (25.87). Moreover, the hypothesis finding in Table 9 shows that Sig. value 0.000 which do not exceed 0.05 level of significance. There we fail to reject the null hypothesis and conclude that there is significant difference on the academic achievement Scores of Males and Females students been taught the concept of chemical bonding using projected instructional media.

The last research question which is to determine the academic mean retention of the senior secondary school students with respect to gender taught concept of chemical bonding with projected instructional media method of teaching in the selected schools in Bosso area council of Niger state was answered in table 6. The table shows that the mean gain of male senior secondary school students taught concept of chemical bonding with projected instructional media (2.56) was greater than the mean gain of female secondary school students taught (0.80). The analysis indicates that the Mean of Post-Test Scores of male students taught concept of chemical bonding with projected instructional media (24.16) was greater than the mean gain of female secondary school students taught (25.07). Moreover, the hypothesis finding in Table 10 shows that Sig. value 0.000 which do not exceed 0.05 level of significance. There we fail to reject the null hypothesis and conclude that there is significant difference on the academic retention of male students taught concept of chemical bonding using projected instructional media and that of the female students.

4.5 Summary of Findings

The overall purpose of this quantitative study was to determine the effect of projected instructional media on students' academic achievement and retention on the "concept of chemical bonding".

The finding shows that the secondary school students which are taught concept of chemical bonding with projected instructional media performed better that those taught using Conventional Method of teaching and that there is significant difference on the academic achievement of students taught concept of chemical bonding using projected instructional media and those taught using conventional method. This is in accordance to Fidanboylu (2014), who proposed that the use of visual aids during teaching, motivates the students and reinforces the learned language and also further improves reading, writing, speaking and listening skills which leads to a better academic performance of the learners. Kwesiga (2013) also supported this theory and stated that a student's academic performance is a function of the number of instructional mediums the school offers, which in turn affect their academic performance.

The findings show that the secondary school students which are taught concept of chemical bonding with projected instructional media possessed high retention ability than those taught using Conventional Method of teaching and that there is significant difference on the academic retention of students taught concept of chemical bonding using projected instructional media and those taught using conventional method. This is in line with Shieh & Yu (2016) who revealed that guided discovery instruction influenced learning and retention. Studies have shown that poor learning and retention in science may be related to the learner's inability to link new knowledge to the previous knowledge and such studies reported that stimulating learning environment, interest, activity-oriented teaching strategies are all that learners need to retain new learned information. The understanding of imagery is of great importance to the learners' retention; therefore, teachers should be encouraged to apply the methods of teaching that will appeal to many senses of the learners.

The finding shows that the male secondary school students which were taught concept of chemical bonding with projected instructional media performed better that the female

students. Moreover, the variation of the mean gain values indicates that the teaching of the concept of chemical bonding with projected instructional media is effective and applicable for both genders and that there is significant difference on the academic achievement Scores of Males and Females students been taught the concept of chemical bonding using projected instructional media. The low participation of female students in science related subjects were attribute to factors such as: - attitude of teachers, students and parents to the idea of women engaging in male career such as Engineering, Technology, Architecture etc.

More also, the finding shows that that the male secondary school students which are taught concept of chemical bonding with projected instructional media possessed high retention ability that the female students. Moreover, the variation of the mean gain values indicate that the teaching of the concept of chemical bonding with projected instructional media is effective and applicable for both genders in alignment with Oluwatosin and Ogbeba (2017) whose study on impact of gender on senior secondary chemistry student's academic achievement in stoichiometry using hands-on activities discovered insignificant difference in average achievement scores between male and female students who were taught stoichiometry. The study also found that there was a significant relationship between the technique and gender of average achievement scores of learners. Also, the results from a study by Fatokun and Omenesa (2015) revealed insignificant variation in both genders differences and academic achievement despite the fact that girls were not as active as boys in the classroom interaction during teaching and learning. Implying, that students can achieve high academic scores irrespective of their gender.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Intoduction

This study researched on the effect of projected instructional media on the achievement and retention of the concept of chemical bonding in secondary schools. A total number of eighty (80) SS2 chemistry students were drawn from two schools in Bosso local government area council, who participated in the study as research subjects.

The study was guided by four research questions and four null hypotheses. Chemistry achievement pre-test and post-test was used as instruments for data collection. Educational Experts validated the instruments and their reliabilities were also estimated.

5.2 Summary of the Study

The pre-chemistry achievement test was administered at the beginning of the study, while the post-chemistry achievement test was administered to the subjects at the end of the teaching. Retention test (RT) was administered one week after the administration of post-chemistry achievement test. Thereafter, the student's scripts were marked, scored and the resulting data subjected to data analysis. The mean scores and standard deviations of the test scores were used in answering research questions. T-Test was used in testing the research hypotheses and the results of data showed that;

1. The secondary school students which are taught concept of chemical bonding with projected instructional media performed better that those taught using Conventional Method of teaching and that there is significant difference on the

academic achievement of students taught concept of chemical bonding using projected instructional media and those taught using conventional method.

2. The finding shows that the secondary school students which are taught concept of chemical bonding with projected instructional media possessed high retention ability than those taught using Conventional Method of teaching and that there is significant difference on the academic retention of students taught concept of chemical bonding using projected instructional media and those taught using conventional method.
3. The finding shows that the male secondary school students which are taught concept of chemical bonding with projected instructional media performed better that the female students.
4. The finding also indicated that the male secondary school students which are taught concept of chemical bonding with projected instructional media possessed high retention ability than the female students.

5.2 Conclusion

From the findings of the study, it can be deducted that the instructional strategies adopted by the teachers greatly affect the students learning of educational concepts because it is evident that the use of projected instructional media could provide a good way for students to learn, understand and retain the facts of chemical bonding and other chemistry concepts. This is usually mirrored in their achievement and extent of retention of learning.

Extraneous variables that can contaminate the result of the study are; testing effect, subjects' interactions and school which might affect the reliability of the test. The researcher did the following to control these variables;

a) The testing effect was controlled by reorganizing the pre- achievement test before they were used as post-test. The reorganizing of the CAT questions ensured that research subjects would not recognize the pre-test questions based on their serial numbers.

b) The same topics were taught in both experimental and control groups to ensure that the difference in the result obtained was due to the instructional material.

c) The school timetable and intact classes were used to avoid the disruption of the school programmes. That also made the students to be in attendance.

d) The students did not know they would be given a retention test after one week of administering the pre-test.

e) The two different schools used were both within the same location, this helped to show that the difference in the grades of the results was as a result of the teaching method and aid used and not just the location.

The use of projected instructional media also assisted in improving the retention of learned content in chemical bonding and therefore, enhanced more interest and exciting effect on both male and female students in experimental group than control group.

5.3 Recommendations

Educational Implications of the Study:

Based on the findings of the study, the following education implications are emphasized below:

1. Pre-service and in-service chemistry teachers should be trained i.e. workshops, symposia and seminars should be organized by Federal and State ministries of education to encourage the use of media in teaching and learning of sciences especially in teaching abstract concepts like chemical bonding and other concepts involving migration of atoms, molecules and particles. It also suggests that for advances in technology and science, teachers should draw attention to technological tools that appeal to more than one sense organs and require interaction with the learner in educational environments, since it has been proven to improve the academic achievement of students and is gender friendly.
2. The outcomes of the study also indicate that the use of projected instructional media improves retention of learned concepts. To encourage meaningful learning, science educators should put in more effort in the development of presentation packages using media in science subjects especially areas involving motions of particles, ions and electrons. If science teachers can arouse and sustain the interest of students using relevant instructional strategies, the learners will achieve higher and retain more of what is learned. This will equip the students intellectually and lead to a remarkable breakthrough in science and technology in our country.
3. Computer education in Nigeria should be involved in the development of software's that will augment teaching and learning of science. This can be done by the collaboration of teachers with software developers.
4. The use of projected instructional media has been recognized to improve achievement, retention and even interest in chemical bonding, therefore, it should be popularized by incorporating them into chemistry curriculum as this is computer age and ICT is used to improve every field of study and human endeavor.

5. The female population as well as that of the male subjects profited equally when taught chemical bonding using projected instructional media and based on this finding, the female and male students should be encouraged to strongly pursue most of the chemistry-based courses like engineering, medicine, etc. since most of the abstract concepts can now be explain using media. It makes such concepts to be tangible and easily concretized.
6. The Nigerian Educational Research and Development Council, individuals and any establishment involved in production of chemistry resource materials, teaching aids like charts, models, and textbooks should develop and produce animation materials in chemistry and other sciences to help the teachers in handling abstract concepts like those involving motion of particles.
7. There should be improved evaluation procedures, which discourages memorization of facts and principles rather, more emphasis should be placed on instructional strategy that will help students retain learned concepts.

5.4 Limitations of the Study

The study had the following limitations;

1. The teaching of the concepts of chemical bonding was carried out using projector and laptop as an alternative rather than giving each student a computer system to manipulate and use. This could affect the results of the study.
2. The researcher was constrained by time as a result, the research was focused on a few selected schools in Bosso Local Government Area. It took the researcher a great deal of time, energy and effort to get the appropriate materials and data for the research work.

5.5 Suggestions for Further Research:

The researcher hereby recommend that other researchers may undertake such study specifically in other parts of the state, principally in other Local Government Areas of Niger State so that comprehensive information can be gotten for further decision making. The following suggestions were made for further research:

1. This study can be carried out using other concepts in chemistry.
2. The use of projected instructional media in the classroom can be extended to other science and non-science subjects and other fields of study.
3. A study of this nature can be conducted using a larger sample.

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APPENDIX I

Table 1.0: Sampled size of Sampled Schools Used

Schools	No of males in SS2 chemistry	No of females in SS2 chemistry	No of students in SS2 chemistry
Ahmadu Bahago Secondary School, Minna Niger state.	83	45	128
Government Day Secondary School Minna, Niger state.	56	31	87
Total	139	76	215

APPENDIX II

Chemistry Achievement Test

Class Number: Gender: Male ☐ Female: ☐ Time: 1hr

Date:

INSTRUCTION: Read each question carefully and circle the correct answer

1. Chlorine atom forms chloride ion by

   (a)Losing one electron (b) Sharing one electron (c) Donating one pair of electrons (d) Gaining one electron

2. Nitrogen, Fluorine and Oxygen are……...in nature

   (a)Electronegativity (b) Electropositivity (c) Metallic (d) Semi-metallic

3. Ionic compounds are characterized by

   (a) Solubility in ethanol (b) High molecular mass (c) High melting point (d) Strong oxidizing ability

4. What type of chemical bonding is involved in the formation of NH_4 from a molecule of ammonia and a proton?

   (a) Covalent bonding (b) Coordinate covalent bonding (c) Ionic bonding (d) Hydrogen bonding

5. A hydrogen atom which has loss an electron contains

   (a) One proton (b) One neutron (c) One proton and one neutron only (d) One proton, one electron

6. Which bond acts like a bridge between two molecules formed by a covalent bond

   (a) Covalent bond (b) Ionic bond (c) Hydrogen bond (d) Metallic bond

7. When sodium atom forms an ion, it …….

   (a) Gains one electron (b) Gains one proton (c) Achieves a noble gas configuration

   (d)Atomic number increases

8. If the difference between the electronegativity of two elements is large, the type of bond that can be formed between them is?

   (a) Covalent bond (b) Ionic bond (c) Metallic bond (d) Hydrogen bond

9. Water molecules contains ……. hydrogen bonds

   (a) Intermolecular bond (b) Intramolecular bond (c) Neither intermolecular nor intramolecular (d) Both intermolecular and intramolecular

10. The relatively high boiling point of water is caused by

    (a) Ionic bonding (b) Hydrogen bonding (c) Metallic bonding (d) Covalent bonding

11. How many electrons are shared in a double bond?

    (a) 2 (b) 4 (c) 6 (d) 8

12. What is the name given to the outermost electron?

    (a) Outside electron (b) Nucleus electron (c) Valence electron (d) Crystal electron

13. What is the charge on the cation in the ionic compound sodium oxide?

    (a) -2 (b) 2 (c) -1 (d) 1

14. The process of removing or adding electrons is called……

    (a) Work (b) Ionization (c) Electrification (d) Rusting

15. How many different types of atoms are in an NH_3 molecule?

    (a) 1 (b) 2 (c) 3 (d) 4

16. Which of the following has the strongest binding power?

    (a) Vander waals forces (b) Metallic bond (c) Hydrogen bond (d) Ionic bond

17. Which among the following is not an example of hydrogen bond?

    (a) H_2O (b) Liquid HCL (c) $NH_{3\,(d)}$ $CHCL_3$

18. In which molecule is there a complete linear arrangement of all atoms?

    (a) NH_3 (b) BF_3 (c) CO_2 (d) CH_4

19. An atom differs from its ion in which among the following

    (a) Mass number (b) Atomic number (c) Neutrons (d) Number of protons

20. The energy which must be transferred to any atom to dislodge an electron is…….

    (a) Ionization energy (b) Quantum mechanical energy (c) Free energy (d) Dissociation energy

APPENDIX III

MARKING SCHEME FOR PRE-TEST

1. D
2. A
3. C
4. A
5. B
6. C
7. C
8. B
9. B
10. B

11. B
12. C
13. D
14. B
15. D
16. D
17. B
18. C
19. D
20. A

APPENDIX IV

LESSON PLAN ON CHEMICAL BONDING USING PROJECTED INSTRUCTIONAL MEDIA

Lesson: 1

Subject: chemistry

Class: SS2 A&B

Topic: Chemical bonding

Sub-topic: Types of chemical bonding (ionic bonding)

Duration: 1hr: 20mins

Gender: Mixed

Average age: 16+

Learning objective: By the end of the lesson the students should be able to:

(i) Identify metals, non-metals and noble gas from the periodic table

(ii) Illustrate how an ionic bond is formed

(iii) Explain the properties of ionic bonds

Rationale: To enable the students understand the importance of chemical bonds found all around them.

Learning materials: periodic table, power-point presentation and white board.

Pre-requisite knowledge: the students have been introduced to the concept of gaining and losing electrons to become ions, in their previous class.

Lesson development

Stage	Teacher activity	Student activity	Learning point
Introduction	The teacher introduces the lesson by using an analogy of how friends can assist themselves with either money or provision when they have enough of it	The students acknowledge the analogy and also relate with it as a normal practice.	Using Students experiences as an introduction to the topic to be taught.

	and their friend is lacking what they already have in excess.		
Stage 1	The teacher projects the periodic table to the student from the projected device and guides the students to identify metals, nonmetals and noble gases	The student observes the periodic table displayed and list examples of metals such as Na, Mg, Li, K, Cu, Ti, Zn etc. Non-metals e.g., C, N, O, P, Cl etc. Noble gases e.g. He, Ne, Ar etc. This is done based on their position on the periodic table as the metals are usually found towards the left, and the non-metals towards the right while the noble gases are non-metals found in the far-right side of the table.	Identifying metals, non-metals and noble gases using the periodic table.
Stage 2	The teacher, using the PowerPoint presentation shows and explain that ionic bonds are formed between cations and anions i.e., a cation is formed when a metal ion loses a valence electron while an anion is formed when a non-metal gains a valence electron. This exchange results in a more stable, noble gas	The student watches the power point presentation and observe how electrons are shared between elements to form ions and also try illustrating ionic bond formation between other elements.	Knowledge acquisition

	electronic configuration for both atoms involved Eg		
Stage 3	The teacher guides the students to explain some of the properties of ionic bonds.	The students mention some of the properties of ionic bonds as: a. Ionic compounds are formed when atoms connect to one another by ionic bonds b. This type of chemical bonding leads to the formation of two oppositely charged. ions i.e., cations and anions. c. The ionic bonded molecules have high melting and boiling points. d. In their aqueous solution or molten state, the ionic bonded molecules are good conductors of electricity e. It is the strongest of all the bonds.	Learning and linkage of previous knowledge of the properties of metals to the current topic.
Evaluation	The teacher evaluates the lesson by asking the students to: 1. Mention three examples each of metals, non-metals and noble gases.	The student answers the questions asked by the teacher.	Actualization of stated objectives.

	2. Describe how an ionic bond is formed. 3. Explain three properties of ionic bond.		
Conclusion	The teacher concludes by summarizing the lesson.	The students listen to the teacher	Clarification of misconception

Lesson: 3

Subject: chemistry

Class: SS2 A&B

Topic: Chemical bonding

Sub-topic: Types of chemical bonding (covalent bonding)

Duration: 1hr: 20mins

Gender: Mixed

Average age: 16+

Learning objective: By the end of the lesson the students should be able to:

(i) define and describe covalent bonding

(ii) explain single, double and triple covalent bonding

(iii)describe how a full outer shell affects reactivity.

Rationale: The knowledge of covalent bonding will help the students to understand the importance of chemical bonds found all around them.

Learning materials: periodic table, power-point presentation and white board.

Pre-requisite knowledge: the students have already been introduced to the concept of chemical bonding in their previous lesson.

Lesson development

Stages	Teacher activity	Student activity	Learning point
Introduction	The teacher introduces the lesson by guiding the students to draw the diagram/structure of an atom and label it showing the proton, neutron and electron and thereafter display the periodic table on the projected media and guides the students to list the non-metals they can recognize from the periodic table	The students draw and label the structure and also observe the periodic table and call out examples of non-metals such as H, O, N, C, halogens etc.	Reviewing of previous knowledge.
Stage 1	The teacher displays a video showing how a covalent bond is formed and guides the student to define covalent bond as sharing of electron pairs between atoms.	The students watch the video and define covalent bonds as the sharing of electrons between atoms.	The students are defining covalent bonding and acquiring knowledge about another type of bond.
Stage 2	The teacher guides the student to describe and explain the types of bonds namely 1. Single bond 2. Double bonds 3. Triple bonds	The students describe the types of bonds as a. Single bond: which is a bond formed when one pair electron is shared between two atoms which is usually a weak bond e.g., Cl-Cl, H-Cl, NH_3 etc. b. Double bond: is a bond formed by the	The students are becoming familiar with the concept of bonding.

		two atoms sharing 2 pairs of electrons which are stronger than the single bond and more reactive e.g., O_2, Co_2 etc. (=) c. Triple bond: is formed when a molecule shares 3 pairs of electrons between 2 atoms. It is the least stable usually connotated with (≡) e.g., N≡N, C_2≡H_2 etc.	
Stage 3	The teacher explains that the number of electrons in the outermost shell of a particular atom determines its reactivity or tendencies to form chemical bonds with other atoms i.e., atoms are most stable, least reactive when their outermost electron shell is full. Noble gases have low reactivity because they have full electron shells. Halogens are highly reactivity because readily gain electron to fill their outermost shell.	The student also responds that 1.More valence electrons add weight to the atom making less reactivity 2.Valence electrons don't affect reactivity.	Students are learning about electron shell.
Evaluation	Teacher evaluate the lesson by asking the student to 1.describe covalent bonding. 2.list the different types of bonding.	The student answers the questions asked.	Actualization of stated objectives.

	3.examine the and describe why a full outer shell affects reactivity.		
Conclusion	The teacher concludes the lesson by summarizing the lesson taught.	The student listens to the teacher attentively.	Clarification of any misconception

APPENDIX V

LESSON PLAN ON CHEMCAL BONDING USING LECTURE METHOD

Lesson: 1

Subject: chemistry

Class: SS2 A&B

Topic: Chemical bonding

Sub-topic: Types of chemical bonding (ionic bonding)

Duration: 1hr: 20mins

Gender: Mixed

Average age: 16+

Learning objective: By the end of the lesson the students should be able to:

(i) identify metals, non-metals and noble gas from the periodic table

(ii) illustrate how an ionic bond is formed

(iii)explain the properties of ionic bonds

Rationale: To enable the students understand the importance of chemical bonds found all around them.

Learning materials: periodic table and white board.

Pre-requisite knowledge: the students have been introduced to the concept of gaining and losing electrons to become ions, in their previous class.

Lesson development

Stage	Teacher activity	Student activity	Learning point
introduction	The teacher introduces the lesson by using an analogy of how friends can assist themselves with either money or provision when they have enough of it and their friend is lacking what they already have in excess.	The students acknowledge the analogy and also relate with it as a normal practice.	Using students' experiences as an introduction to the topic to be taught.
Stage 1	The teacher explains that the identification of metals, nonmetals and noble gases can be done by looking at the position of the elements on the periodic table as the metals are usually found towards the left, and the non-metals towards the right while the noble gases are non-metals found in the far-right side of the table.	The student list examples of metals such as Na, Mg, Li, K, Cu, Ti, Zn etc. Non-metals e.g., C, N, O, P, Cl etc. Noble gases e.g. He, Ne, Ar etc.	Identifying metals, non-metals and noble gases.
Stage 2	The teacher explains that ionic bonds are formed between cations and anions i.e., a cation is formed when a metal ion loses a valence electron while an anion is formed when a non-metal gains a valence electron.	The students listen to the teacher as she explains how electrons are shared between elements to form ions and also try illustrating ionic bond formation between other elements.	Knowledge acquisition

	This exchange results in a more stable, noble gas electronic configuration for both atoms involved.		
Stage 3	The teacher explains some of the properties of ionic bonds as: a. Ionic compounds are formed when atoms connect to one another by ionic bonds b. This type of chemical bonding leads to the formation of two oppositely charged. ions i.e., cations and anions. c. The ionic bonded molecules have high melting and boiling points. d. In their aqueous solution or molten state, the ionic bonded molecules are good conductors of electricity e. It is the strongest of all the bonds.	The students listen to the teacher and repeat after her.	Students are gaining knowledge.
Evaluation	The teacher evaluates the lesson by asking the students to: 1. Mention three examples each of	The student answers the questions asked by the teacher.	Actualization of stated objectives.

	metals, non-metals and noble gases. 2. Describe how an ionic bond is formed. 3. Explain three properties of ionic bond.		
Conclusion	The teacher concludes by summarizing the lesson.	The students listen to the teacher	Clarification of misconception

APPENDIX VI

***Table* 2.1:** The table shows the academic mean and standard deviation of the achievement of senior secondary school students taught concept of chemical bonding with projected instructional media and those taught using conventional method of teaching in the selected schools in Bosso area council of Niger state.

Projected Instructional Media Method						Conventional Method				
Ahmadu Bahago Secondary School						**Government Day Secondary School**				
Pupils	**Gender**	**Pre-Test**	**Post-Test**	**Retentive Test**		**Pupils**	**Gender**	**Pre-Test**	**Post-Test**	**Retentive Test**
1.	F	14	20	23		**1.**	F	14	18	21
2.	F	12	28	27		**2.**	F	16	21	25
3.	F	10	20	20		**3.**	F	16	20	24
4.	F	12	28	27		**4.**	F	06	18	16
5.	F	8	26	23		**5.**	F	08	12	13
6.	F	16	24	27		**6.**	F	12	20	21
7.	F	14	32	31		**7.**	F	10	16	17
8.	F	10	16	17		**8.**	F	20	24	29

9.	F	18	36	36
10.	F	12	22	23
11.	F	12	26	25
12.	F	14	24	25
13.	F	04	28	21
14.	F	08	26	23
15.	F	10	32	28
16.	M	08	20	19
17.	M	12	28	27
18.	M	14	30	29
19.	M	04	28	21
20.	M	12	24	24
21.	M	04	22	17
22.	M	04	18	15
23.	M	16	30	31
24.	M	04	24	19
25.	M	12	30	28
26.	M	08	30	25
27.	M	08	36	29
28.	M	08	30	25
29.	M	10	34	29
30.	M	04	20	16
31.	M	06	14	13
32.	M	10	30	27
33.	M	16	30	31

9.	F	14	18	21
10.	F	10	14	16
11.	F	12	14	17
12.	F	12	18	20
13.	F	18	22	27
14.	F	14	16	20
15.	F	06	18	16
16.	M	10	16	17
17.	M	14	16	20
18.	M	14	26	27
19.	M	10	18	19
20.	M	20	36	37
21.	M	24	32	37
22.	M	12	12	16
23.	M	08	16	16
24.	M	08	14	15
25.	M	12	18	20
26.	M	08	14	15
27.	M	10	16	17
28.	M	10	18	19
29.	M	10	16	17
30.	M	12	18	20
31.	M	12	12	16
32.	M	10	10	13
33.	M	16	34	33

34.	M	16	38	36		**34.**	M	04	38	28
35.	M	10	14	16		**35.**	M	16	20	24
36.	M	10	32	28		**36.**	M	16	18	23
37.	M	06	24	20		**37.**	M	14	14	19
38.	M	14	36	33		**38.**	M	08	14	15
39.	M	10	28	25		**39.**	M	08	12	13
40.	M	14	18	21		**40.**	M	10	16	17
Total		414	1056	980.00		**Total**		484	743	818.00
Mean		10.35	26.40	24.50		**Mean**		12.10	18.58	20.45
S. D		3.92	6.11	5.57		**S. D**		4.17	6.48	6.08

APPENDIX VII

***Table* 4:** The table shows the academic mean and standard deviation of the achievement of senior secondary school students with respect to gender taught concept of chemical bonding with projected instructional media method of teaching in the selected schools in Bosso area council of Niger state.

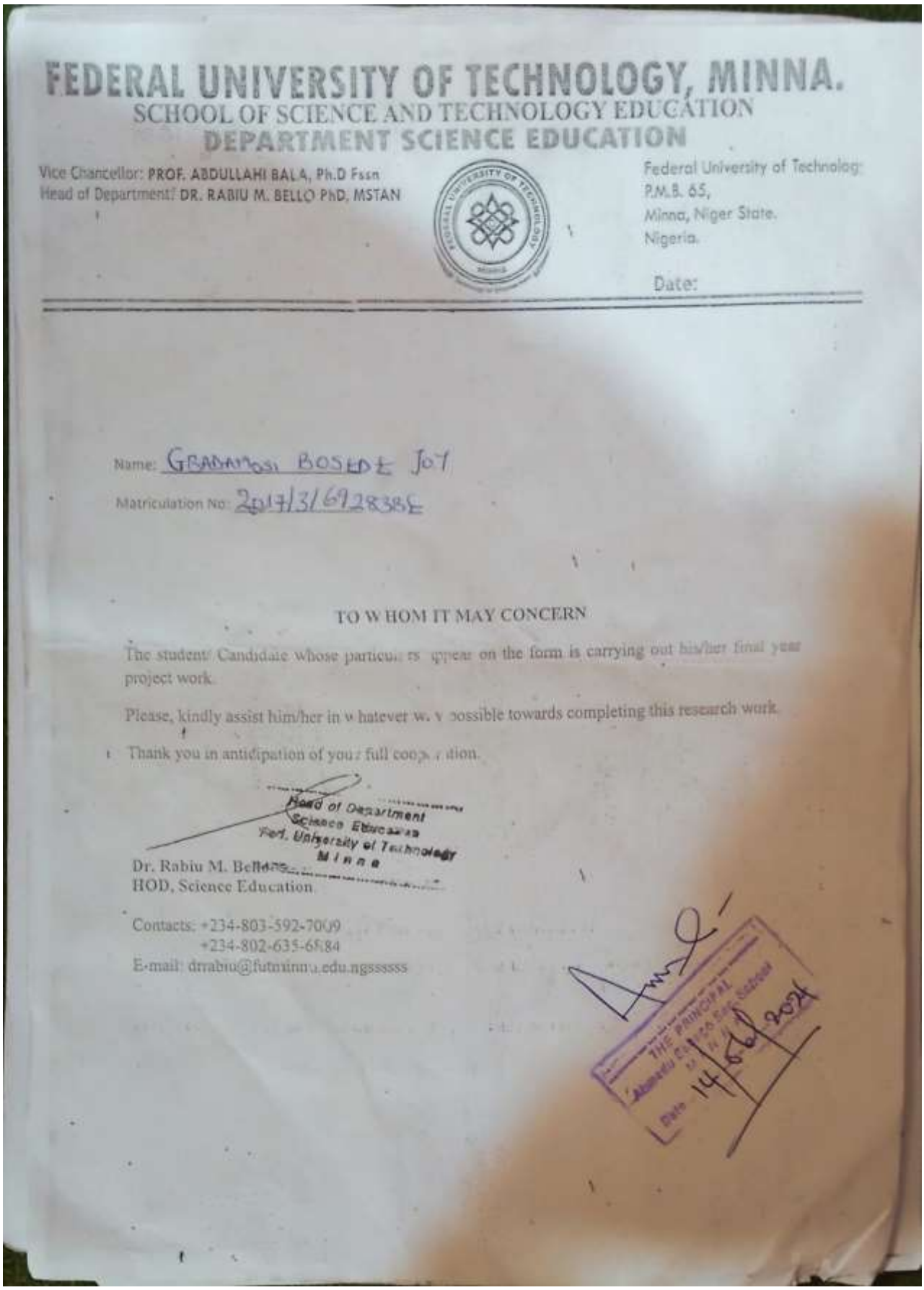
Projected Instructional Media Method

Pupils	**Gender**	**Pre-Test**	**Post-Test**	**Retentive Test**		**Pupils**	**Gender**	**Pre-Test**	**Post-Test**	**Retentive Test**
1.	M	08	20	19		**1.**	F	14	20	23
2.	M	12	28	27		**2.**	F	12	28	27
3.	M	14	30	29		**3.**	F	10	20	20
4.	M	04	28	21		**4.**	F	12	28	27
5.	M	12	24	24		**5.**	F	8	26	23
6.	M	04	22	17		**6.**	F	16	24	27
7.	M	04	18	15		**7.**	F	14	32	31
8.	M	16	30	31		**8.**	F	10	16	17
9.	M	04	24	19		**9.**	F	18	36	36

10.	M	12	30	28
11.	M	08	30	25
12.	M	08	36	29
13.	M	08	30	25
14.	M	10	34	29
15.	M	04	20	16
16.	M	06	14	13
17.	M	10	30	27
18.	M	16	30	31
19.	M	16	38	36
20.	M	10	14	16
21.	M	10	32	28
22.	M	06	24	20
23.	M	14	36	33
24.	M	10	28	25
25.	M	14	18	21
Total		240.00	668.00	604.00
Mean		9.60	26.72	24.16
S. D		4.04	6.68	6.17

10.	F	12	22	23
11.	F	12	26	25
12.	F	14	24	25
13.	F	04	28	21
14.	F	08	26	23
15.	F	10	32	28
Total		174.00	388.00	376.00
Mean		11.60	25.87	25.07
S. D		3.48	5.21	4.62

APPENDIX VIII



FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT SCIENCE EDUCATION

Vice Chancellor: PROF. ABDULLAHI BALA, Ph.D Fssn
Head of Department: DR. RABIU M. BELLO PhD, MSTAN

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P.M.B. 65,
Minna, Niger State.
Nigeria.

Date:

Name: GBADAMOSI BOSEDE JOY

Matriculation No: 2017/3/69283BE

TO W HOM IT MAY CONCERN

The student/ Candidate whose particu rs appear on the form is carrying out his/her final year project work.

Please, kindly assist him/her in w hatever w. y possible towards completing this research work.

Thank you in antidipation of you: full coop. dion.

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THE PRINCIPAL
Date 14/6/2024

SECTION B

Name of the validator: Mrs Habiba Yenimi

Designation/Rank: Principal Lecturer

Name of institution: Niger State College of Education, Minna

Department/ School: Chemistry / School of Sciences

Telephone No/GSM No: 07032130516

E-Mail Address: yenmsh2012@gmail.com

Hyenimi 15/06/2021

Signature, Date and stamp (if available)

RESEARCH INSTRUMENT VALIDATION FORM

Sir/Ma,

The candidate GBADAMOSI JOY BOSEDE with Admission Number 2017/3/69283BE is a student of the department. You are requested to make amends or inputs that will improve the quality of the instrument. Your professional expertise is expected to assist the researcher towards the award of the degree.

Thank you.

Dr. Rablu M. Bello

HOD (Signature, Date & Official stamp)

Title of the Research Instrument: Chemistry Achievement Test

SECTION A

1. Appropriateness of the Research Instrument title: Appropriate
2. Suggest amendment if not appropriate: Nil
3. Completeness of Bio-data Information: To be slightly modify.
4. Suggest inputs if incomplete Add name of School to the bio-data
5. Suitability of items generated The items generated are quite adequate and standard
6. Structure of the questionnaire/ test items generated The questions are well structured
7. Structure of the instrument in line with the objectives of the study.
   The structure of the instrument agrees with the set objectives
8. Items coverage and distribution across constructs and domains measured
   The items are in depth and well distributed
9. Appropriateness of the instrument in relation to the type of data to be collected
   The instrument is appropriate to the required data
10. What is the general overview and outlook of the instrument?
    The instrument is well articulated
11. Rate the Instrument between 1-10 7/10