PROBLEMS AND PROSPECTS OF TEACHING CHEMISTRY IN SECONDARY SCHOOLS IN GUSAU METROPOLIS ZAMFARA STATE NIGERIA

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF HUMANITIES AND EDUCATION, FEDERAL UNIVERSITY GUSAU, ZAMFARA IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCINCE EDUCATION DEGREE IN CHEMISTRY (BSc. Ed CHEMISTRY).

DEPARTMENT OF SCIENCE EDUCATION
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CERTIFICATION

This research project has been supervised, examined, read and approved as part of the requirements for the Award of Bachelor of Science Education Degree in Chemistry (B.Sc. Ed. Chemistry) Federal University Gusau, Zamfara state

Dr. Bashir Suleiman
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31/08/2018
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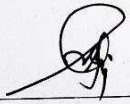

Dr. Bashir Suleiman
Head of Department

31/10/2018
Date

External Supervisor

Date

DEDICATION

We humbly dedicate this research project to our Good-humoured parents for their prayers, moral and financial support throughout this career.

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All thanks and gratitudes are due to Allah (SWT); most Gracious, most Merciful, most [illegible] and the Sustainer of life, Who sustained our lives and bestowed His multitudinous blessings, mercy and favors unto us throughout this career and in the course of this research project. May the salutations and benedictions of Allah be upon our noble prophet Muhammad (S.A.W).

Our profound and sincere gratitude goes to our supervisor Dr. Bashir [illegible], whose experience, knowledge, guidance and relentless efforts made this work a success, through Allah's will. May Allah bless you and your family, set right in your affairs and guide you through all your endeavours for the time you spared in attending to this project despite your tight schedules.

We remain indebted to all our noble and able lecturers for the tremendous and [illegible] efforts made in imparting the desired knowledge in us, particularly Dr. Gidado I., Dr. [illegible] and Mr. Victor for paving a way for us in the light of a research work through ED [illegible] and [illegible] (Research Method and Statistics), the staff and students of the schools used in this study for their cooperation and also to those whose works we cited. May God reward you abundantly.

Our heartfelt, sincere and devout appreciation goes to our amiable and good-[illegible] parents for their unceasing prayers, moral and financial support, and to our brothers and sisters. May Allah (SWT) grant you a blissful life, sustenance, guidance and protection in all your affairs [illegible] and hereafter, Amen.

Finally, we acknowledge and appreciate our humble colleagues/friends/course mates for making impacts in our lives in one way or the other, it was very nice living and studying with you and we miss you all. May the Almighty Allah be with you wherever you may find yourselves, [illegible]

ABSTRACT

Problems and prospects of teaching chemistry in secondary schools of Gusau metropolis Zamfara state were investigated in this study. The population of the study covers the 73 senior secondary schools (50 private and 23 publicly owned). The sample was made up of 15 senior secondary schools, 45 chemistry teachers and 150 chemistry students using simple random and cluster sampling procedures. Teachers' and students' questionnaires were used to collect information from the affected schools. The data collected were analyzed using simple descriptive statistics that is, frequency counts and percentages. The major findings of the study were: seventy one point one-one percent (71.11%) of chemistry teachers in secondary schools of Gusau metropolis Zamfara state are not professionally trained teachers, forty five percent (45%) of the laboratories were not well-organized, demonstration method was predominantly used by the teachers while other recommended methods were very rare or not used, most of the schools have insufficient supply of instructional materials/teaching aids. The study recommended among others that, Government and proprietors should provide well-organized laboratories and sufficient instructional materials or teaching aids for effective teaching and learning, professionalization of teaching in Nigeria is very essential in order to ensure that only professionally qualified teachers should be employed for teaching, Government and proprietors should sponsor teachers to attend seminars and workshops in order for the teachers to be up to date, Government and proprietors should create conducive teaching-learning environment.

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CHAPTER ONE

INTRODUCTION

Background of the Study

emistry from the ancient Egypt an word "Khemia" meaning "blackness", therefore chemy is the black art.

hemistry according to Oxford En lish Dictionary is the transmutation or earth, is the science of matter at the atomic to mol ecular scale, dealing primarily with collections of atoms such as molecules, crystals and me als. It's one of the pure branches science deals with composition; properties of matter it probes into the principles govern the changes matter undergoes. It is practical subject whic h equip students with concepts, and skills that are useful in solving day to day problems of lif e. Amasw (2018), the study of chemistry as a practical subject in account of the matter is a ool for exploring and probing the unknown around the environment for the benefit of individ ual, family and community in general.

Chemistry as well as other field of sc ence has developed through a series of discoveries, how do scientists make their discoveries? Scientists are very alert and inquisitive they use their sense to observe what is happening around them from a given set of observation, they also see certain pattern they put toward a reasonable explanation or hypothesis and can use appropriate experiments to test it the n carefully record the observation and the result of the experiment.

According to Erinosho (2008), the se nior secondary school science curricular are designed to build on the integrated science progra nme, with aim to providing advancement in knowledge and deeper understanding of the con ept of integrated science that are learned. Emphasis is

on the specialization of the subject with overall goal of stimulating the interest in science among student and proting scientific literacy for functional living in the society, the integrated science contents are organized around major unifying themes that are taught in first three years of secondary school which include Physics, Chemistry and Chemistry.

The Oxford Advance Learner Dictionary 7th Edition (2005), put teaching as showing somebody how to do something so that they will be able to do it themselves to gives somebody information about a particular subject to help somebody learn something. Farrell and Oliveira (1993) posit that teaching can be seen as the logical and strategic acts donating interaction between the teacher and students as they operates on some kind of subject matter. Teaching involves imparting verifiable facts and beliefs; it encourages students' participation and expression of their views.

Effective teaching results in effective learning and as quite expected a negative rendering of this claim is also true. Detecting teaching result in defect learning thus, a good chemistry teacher posses good teaching quality, expertise proper management ability and good interactive skills. The student learning styles and academic achievement in chemistry is not supposed to be neglected. So to ascertain the competence of a chemistry teacher, one could need to look at the all competence of his student and their performance in chemistry examination and ability to stand out in or cope with advanced area in their pursuit of further studies in chemistry or other field related to it.

A probe into the problems and perspective of teaching chemistry is right step in the right direction. According to Nwachukwu (1999), some challenges/problems encountered in the teaching and learning chemistry in Nigeria includes in adequate numbers of well trained chemistry teachers, poorly equipped laboratories, in adequate provision of chemistry teaching aids, poor understanding of the technical terms (languages) in chemistry text books poor/low

socio-economic status of chemistry students parents, student environmental condition, examination malpractice among others. These also contribute immensely to the problems of teaching chemistry in the Gusau Metropolis, Zamfara State.

Omoifor (2012), indicate poor enrolment in science and technology education, the question is now, why is there high rate of poor performance in chemistry, why do student have low rate of interest in chemistry? A look through science education literature in the past two decades and summarizers of examiners report of the results by externals examination councils, example West African Examination Council (WAEC) indicate that all is not well in the teaching and learning process of chemistry, poor performance of student in chemistry as a subject is on the rise, on an average scale, more than 40% of student who sit for chemistry examination fail poor performance as recorded by (WAEC) is also collaborated by result from (NECO) National Examination Council.

(Omoifor, 2012) shown that poor performance of student in chemistry it a clear indication that there is great problems of lack of interest for that fact that chemistry principles are use in our day-to-day human activities and its peculiarity in the field of science student ought to be high, but over the years enrolment in the subject chemistry has been indicating that the level of interest has significantly dropped therefore, is an attempt to in co-operate local practice (chemistry at home) in the teaching of chemistry at school.

1.2 Statement Of The Study

In view of diverse applications of chemistry in human endeavours, the problem of teaching chemistry in secondary schools, as demonstrated in the performance of students in chemistry examinations and advanced studies in life science is a serious concern to stakeholders and threat to the future of the subject in Nigeria, and calls for urgent attention. This study

therefore investigates the problems and prospects of teaching chemistry in secondary schools in Gusau Metropolis, Local Government of Zamfara State Nigeria.

1.3 Objective Of The Study

The main objectives of this study are to:

i. Identify the problems of teaching chemistry in secondary schools in Gusau metropolis.

ii. Determine if the problems are similar between public and private schools.

iii. Determine whether the problems are similar as perceived by teachers and students.

iv. Investigate whether the problems are similar as perceived by male and female students.

1.4 Research Questions

The following research questions were formulated to guide the study;

i. What are the problems of teaching chemistry in secondary schools of Gusau metropolis?

ii. Does the problems of teaching chemistry manifest in both public and private schools?

iii. Are the problems of teaching chemistry similar as perceived by teachers and the students?

iv. Are the problems of teaching chemistry similar as perceived by male and female students?

1.5 Significance Of The Study

Findings of this study will be useful to teachers of chemistry, students, education authorities and government as:

i. It will help chemistry teachers to identify the problems of teaching the subject at secondary school level and also how to overcome the problems.

ii. It will enable students to be aware of the problems affecting their performance in chemistry and also have solution to these problems.

iii. It will help to awaken education authorities school proprietors and government to employ qualified chemistry teachers, motivate them by increment of salaries and wages, encouraging them to seek out professional courses or workshops, providing the teachers instructional materials required to facilitate teaching & learning. And by providing them the opportunities to take breaks, make them good human resource policies to appreciate and encourage the teachers, supervise the adherence of teachers to map out policies and recommended teaching methods and techniques to provide laboratories, laboratory equipments and infrastructural facilities. This work will also serve as a reference point for further research in this direction

1.6 Scope And Delimitation Of The Study

The study was restricted to the problems and prospects of teaching chemistry in secondary schools in Gusau metropolis of Zamfara State, Nigeria. From the seventy three (73) secondary schools in the metropolis, fifty three (53) were private schools while the other twenty (20) were public schools, Only fifteen (15) schools were randomly selected. The researchers will visit both private and public schools in the metropolis to collect data. Ten (10) of the schools to be visited will be owned by private individuals that have senior classes 1-3 and the other five (5) schools will be owned by government that also have senior classes 1-3.

1.7 Definition Of Terms

CHEMISTRY: is the scientific discipline involved with compounds composed of atoms, i.e. elements, and molecules, i.e. combinations of atoms: their composition, structure, properties, behavior and the changes they undergo during a reaction with other compounds.

LABORATORY: A laboratory is a facility that provides controlled conditions in which scientific or technological research, experiments, and measurement may be performed.

TEACHING: Is the profession of those who give instruction, especially in an elementary or a secondary school or in a university.

METHOD: Is a procedure or process for attaining an object: such as. How to use method in a sentence. Synonym Discussion of method.

TECHNIQUE: Is a way of carrying out a particular task, especially the execution or performance of an artistic work or a scientific procedure.

PROSPECT: Prospect is from the Latin word prospectus which means a "view or outlook." A prospect is still a way of looking ahead and expecting good things. It's like potential in that it's something that might be but isn't yet.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

The views of scholars who had worked on this subject are the concern of this chapter, and have been organized according to the following:

1. Nature and importance of Chemistry
2. Importance of laboratories in Chemistry education
3. Method and technique use in teaching Chemistry
4. Chemistry teacher in secondary school
5. Student altitude toward Chemistry

2.1 Nature and Importance Of Chemistry

Chemistry the science that deals with the properties, composition, and structure of substances (defined as elements and compounds), the transformations they undergo, and the energy that is released or absorbed during these processes. Every substance, whether naturally occurring or artificially produced, consists of one or more of the hundred-odd species of atoms that have been identified as elements. Although these atoms, in turn, are composed of more elementary particles, they are the basic building blocks of chemical substances; there is no quantity of oxygen, mercury, or gold, for example, smaller than an atom of that substance. Chemistry, therefore, is concerned not with the subatomic domain but with the properties of atoms and the laws governing their combinations and how the knowledge of these properties can be used to achieve specific purposes.

The great challenge in chemistry is the development of a coherent explanation of the complex behaviour of materials, why they appear as they do, what gives them their enduring properties, and how interactions among different substances can bring about the formation of new substances and the destruction of old ones. From the earliest attempts to understand the material world in rational terms, chemists have struggled to develop theories of matter that satisfactorily explain both permanence and change. The ordered assembly of indestructible atoms into small and large molecules, or extended networks of intermingled atoms, is generally accepted as the basis of permanence, while the reorganization of atoms or molecules into different arrangements lies behind theories of change. Thus chemistry involves the study of the atomic composition and structural architecture of substances, as well as the varied interactions among substances that can lead to sudden, often violent reactions.

Chemistry also is concerned with the utilization of natural substances and the creation of artificial ones. Cooking, fermentation, glass making, and metallurgy are all chemical processes that date from the beginnings of civilization. Today, vinyl, Teflon, liquid crystals, semiconductors, and superconductors represent the fruits of chemical technology. The 20th century has seen dramatic advances in the comprehension of the marvelous and complex chemistry of living organisms, and a molecular interpretation of health and disease holds great promise. Modern chemistry, aided by increasingly sophisticated instruments, studies materials as small as single atoms and as large and complex as DNA(deoxyribonucleic acid), which contains millions of atoms. New substances can even be designed to bear desired characteristics and then synthesized. The rate at which chemical knowledge continues to accumulate is remarkable. Over time more than 8,000,000 different chemical substances, both natural and artificial, have been characterized and produced. The number was less than 500,000 as recently as 1965.

Intimately interconnected with the intellectual challenges of chemistry are those associated with industry. In the mid-19th century the German chemist Liebig commented that the wealth of a nation could be gauged by the amount of sulfuric acid it produced. This acid, essential too many manufacturing processes, remains today the leading chemical product of industrialized countries. As Liebig recognized, a country that produces large amounts of sulfuric acid is one with a strong chemical industry and a strong economy as a whole. The production, distribution, and utilization of a wide range of chemical products is common to all highly developed nations. In fact, one can say that the "iron age" of civilization is being replaced by a "polymer age," for in some countries the total volume of polymers now produced exceeds that of iron.

The Scope of Chemistry

The days are long past when one person could hope to have a detailed knowledge of all areas of chemistry. Those pursuing their interests into specific areas of chemistry communicate with others who share the same interests. Over time a group of chemists with specialized research interests become the founding members of an area of specialization. The areas of specialization that emerged early in the history of chemistry, such as organic, inorganic, physical, analytical, and industrial chemistry, along with biochemistry, remain of greatest general interest. There has been, however, much growth in the areas of polymer, environmental, and medicinal chemistry during the 20th century. Moreover, new specialities continue to appear, as, for example, pesticide, forensic, and computer chemistry.

Organic chemistry

Organic compounds are based on the chemistry of carbon. Carbon is unique in the variety and extent of structures that can result from the three-dimensional connections of its atoms. The process of photosynthesis converts carbon dioxide and water to oxygen and compounds

known as carbohydrates. Both cellulose, the substance that gives structural rigidity to plants, and starch, the energy storage product of plants, are polymeric carbohydrates. Simple carbohydrates produced by photosynthesis form the raw material for the myriad organic compounds found in the plant and animal kingdoms. When combined with variable amounts of hydrogen, oxygen, nitrogen, sulfur, phosphorus, and other elements, the structural possibilities of carbon compounds become limitless, and their number far exceeds the total of all nonorganic compounds. A major focus of organic chemistry is the isolation, purification, and structural study of these naturally occurring substances. Many natural products are simple molecules. Examples include formic acid (HCO_2H) in ants, ethyl alcohol (C_2H_5OH) in fermenting fruit, and oxalic acid ($C_2H_2O_4$) in rhubarb leaves. Other natural products, such as penicillin, vitamin B_{12}, proteins, and nucleic acids, are exceedingly complex. The isolation of pure natural products from their host organism is made difficult by the low concentrations in which they may be present. Once they are isolated in pure form, however, modern instrumental techniques can reveal structural details for amounts weighing as little as one-millionth of a gram. The correlation of the physical and chemical properties of compounds with their structural features is the domain of physical organic chemistry. Once the properties endowed upon a substance by specific structural units termed functional groups are known, it becomes possible to design novel molecules that may exhibit desired properties. The preparation, under controlled laboratory conditions, of specific compounds is known as synthetic chemistry. Some products are easier to synthesize than to collect and purify from their natural sources. Tons of vitamin C, for example, are synthesized annually. Many synthetic substances have novel properties that make them especially useful. Plastics are a prime example, as are many drugs and agricultural chemicals. A continuing challenge for synthetic chemists is the structural complexity of most organic substances. To synthesize a desired substance, the atoms must be pieced together in the correct order and with the proper

three-dimensional relationships. Just as a given pile of lumber and bricks can be assembled in many ways to build houses of several different designs, so too can a fixed number of atoms be connected together in various ways to give different molecules. Only one structural arrangement out of the many possibilities will be identical with a naturally occurring molecule. The antibiotic erythromycin, for example, contains 37 carbon, 67 hydrogen, and 13 oxygen atoms, along with one nitrogen atom. Even when joined together in the proper order, these 118 atoms can give rise to 262,144 different structures, only one of which has the characteristics of natural erythromycin. The great abundance of organic compounds, their fundamental role in the chemistry of life, and their structural diversity have made their study especially challenging and exciting. Organic chemistry is the largest area of specialization among the various fields of chemistry.

Inorganic chemistry

Modern chemistry, which dates more or less from the acceptance of the law of conservation of mass in the late 18th century, focused initially on those substances that were not associated with living organisms. Study of such substances, which normally have little or no carbon, constitutes the discipline of inorganic chemistry. Early work sought to identify the simple substances namely, the elements that are the constituents of all more complex substances. Some elements, such as gold and carbon, have been known since antiquity, and many others were discovered and studied throughout the 19th and early 20th centuries. Today, more than 100 are known. The study of such simple inorganic compounds as sodium chloride (common salt) has led to some of the fundamental concepts of modern chemistry, the proportions providing one notable example. This law states that for most pure chemical substances the constituent elements are always present in fixed proportions by mass (*e.g.*, every 100 grams of salt contains 39.3 grams of sodium and 60.7 grams of chlorine). The

crystalline form of salt, known as halite, consists of intermingled sodium and chlorine atoms, one sodium atom for each one of chlorine. Such a compound, formed solely by the combination of two elements, is known as a binary compound. Binary compounds are very common in inorganic chemistry, and they exhibit little structural variety. For this reason, the number of inorganic compounds is limited in spite of the large number of elements that may react with each other. If three or more elements are combined in a substance, the structural possibilities become greater.

After a period of quiescence in the early part of the 20th century, inorganic chemistry has again become an exciting area of research. Compounds of boron and hydrogen, known as boranes, have unique structural features that forced a change in thinking about the architecture of inorganic molecules. Some inorganic substances have structural features long believed to occur only in carbon compounds, and a few inorganic polymers have even been produced. Ceramics are materials composed of inorganic elements combined with oxygen. For centuries ceramic objects have been made by strongly heating a vessel formed from a paste of powdered minerals. Although ceramics are quite hard and stable at very high temperatures, they are usually brittle. Currently, new ceramics strong enough to be used as turbine blades in jet engines are being manufactured. There is hope that ceramics will one day replace steel in components of internal-combustion engines. In 1987 a ceramic containing yttrium, barium, copper, and oxygen, with the approximate formula $YBa_2Cu_3O_7$, was found to be a superconductor at a temperature of about 100 K. A superconductor offers no resistance to the passage of an electrical current, and this new type of ceramic could very well find wide use in electrical and magnetic applications. A superconducting ceramic is so simple to make that it can be prepared in a high school laboratory. Its discovery illustrates the unpredictability of chemistry, for fundamental discoveries can still be made with simple equipment and inexpensive materials.

Many of the most interesting developments in inorganic chemistry bridge the gap with other disciplines. Organometallic chemistry investigates compounds that contain inorganic elements combined with carbon-rich units. Many organometallic compounds play an important role in industrial chemistry as catalysts, which are substances that are able to accelerate the rate of a reaction even when present in only very small amounts. Some success has been achieved in the use of such catalysts for converting natural gas to related but more useful chemical substances. Chemists also have created large inorganic molecules that contain a core of metal atoms, such as platinum, surrounded by a shell of different chemical units. Some of these compounds, referred to as metal clusters, have characteristics of metals, while others react in ways similar to biologic systems. Trace amounts of metals in biologic systems are essential for processes such as respiration, nerve function, and cell metabolism. Processes of this kind form the object of study of bioinorganic chemistry. Although organic molecules were once thought to be the distinguishing chemical feature of living creatures, it is now known that inorganic chemistry plays a vital role as well.

Biochemistry

As understanding of inanimate chemistry grew during the 19th century, attempts to interpret the physiological processes of living organisms in terms of molecular structure and reactivity gave rise to the discipline of biochemistry. Biochemists employ the techniques and theories of chemistry to probe the molecular basis of life. An organism is investigated on the premise that its physiological processes are the consequence of many thousands of chemical reactions occurring in a highly integrated manner. Biochemists have established, among other things, the principles that underlie energy transfer in cells, the chemical structure of cell membranes, the coding and transmission of hereditary information, muscular and nerve function, and biosynthetic pathways. In fact, related biomolecules have been found

to fulfill similar roles in organisms as different as bacteria and human beings. The study of biomolecules, however, presents many difficulties. Such molecules are often very large and exhibit great structural complexity; moreover, the chemical reactions they undergo are usually exceedingly fast. The separation of the two strands of DNA, for instance, occurs in one-millionth of a second. Such rapid rates of reaction are possible only through the intermediary action of biomolecules called enzymes. Enzymes are proteins that owe their remarkable rate-accelerating abilities to their three-dimensional chemical structure. Not surprisingly, biochemical discoveries have had a great impact on the understanding and treatment of disease. Many ailments due to inborn errors of metabolism have been traced to specific genetic defects. Other diseases result from disruptions in normal biochemical pathways.

Frequently, symptoms can be alleviated by drugs, and the discovery, mode of action, and degradation of therapeutic agents is another of the major areas of study in biochemistry. Bacterial infections can be treated with sulfonamides, penicillins, and tetracyclines, and research into viral infections has revealed the effectiveness of acyclovir against the herpes virus. There is much current interest in the details of carcinogenesis and cancer chemotherapy. It is known, for example, that cancer can result when cancer-causing molecules, or carcinogens as they are called, react with nucleic acids and proteins and interfere with their normal modes of action. Researchers have developed tests that can identify molecules likely to be carcinogenic. The hope, of course, is that progress in the prevention and treatment of cancer will accelerate once the biochemical basis of the disease is more fully understood.

The molecular basis of biologic processes is an essential feature of the fast-growing disciplines of molecular Chemistry and biotechnology. Chemistry has developed methods for

rapidly and accurately determining the structure of proteins and DNA. In addition, efficient laboratory methods for the synthesis of genes are being devised. Ultimately, the correction of genetic diseases by replacement of defective genes with normal ones may become possible.

Physical chemistry

Many chemical disciplines, such as those already discussed, focus on certain classes of materials that share common structural and chemical features. Other specialties may be centred not on a class of substances but rather on their interactions and transformations. The oldest of these fields is physical chemistry, which seeks to measure, correlate, and explain the quantitative aspects of chemical processes. The Anglo-Irish chemist Robert Boyle, for example, discovered in the 17th century that at room temperature the volume of a fixed quantity of gas decreases proportionally as the pressure on it increases. Thus, for a gas at constant temperature, the product of its volume V and pressure P equals a constant number *i.e.*, PV = constant. Such a simple arithmetic relationship is valid for nearly all gases at room temperature and at pressures equal to or less than one atmosphere. Subsequent work has shown that the relationship loses its validity at higher pressures, but more complicated expressions that more accurately match experimental results can be derived. The discovery and investigation of such chemical regularities, often called laws of nature, lie within the realm of physical chemistry. For much of the 18th century the source of mathematical regularity in chemical systems was assumed to be the continuum of forces and fields that surround the atoms making up chemical elements and compounds. Developments in the 20th century, however, have shown that chemical behaviour is best interpreted by a quantum mechanical model of atomic and molecular structure. The branch of physical chemistry that is largely devoted to this subject is theoretical chemistry. Theoretical chemists make extensive use of computers to help them solve complicated mathematical equations.

Other branches of physical chemistry include chemical thermodynamics, which deals with the relationship between heat and other forms of chemical energy, and chemical kinetics, which seeks to measure and understand the rates of chemical reactions. Electrochemistry investigates the interrelationship of electric current and chemical change. The passage of an electric current through a chemical solution causes changes in the constituent substances that are often reversible *i.e.*, under different conditions the altered substances themselves will yield an electric current. Common batteries contain chemical substances that, when placed in contact with each other by closing an electrical circuit, will deliver current at a constant voltage until the substances are consumed. At present there is much interest in devices that can use the energy in sunlight to drive chemical reactions whose products are capable of storing the energy. The discovery of such devices would make possible the widespread utilization of solar energy.

There are many other disciplines within physical chemistry that are concerned more with the general properties of substances and the interactions among substances than with the substances themselves. Photochemistry is a specialty that investigates the interaction of light with matter. Chemical reactions initiated by the absorption of light can be very different from those that occur by other means. Vitamin D, for example, is formed in the human body when the steroid ergosterol absorbs solar radiation; ergosterol does not change to vitamin D in the dark.

A rapidly developing sub-discipline of physical chemistry is surface chemistry. It examines the properties of chemical surfaces, relying heavily on instruments that can provide a chemical profile of such surfaces. Whenever a solid is exposed to a liquid or a gas, a reaction occurs initially on the surface of the solid, and its properties can change dramatically as a result. Aluminum is a case in point: it is resistant to corrosion precisely because the surface of

the pure metal reacts with oxygen to form a layer of aluminum oxide, which serves to protect the interior of the metal from further oxidation. Numerous reaction catalysts perform their function by providing a reactive surface on which substances can react.

Analytical chemistry

Most of the materials that occur on Earth, such as wood, coal, minerals, or air, are mixtures of many different and distinct chemical substances. Each pure chemical substance (*e.g.*, oxygen, iron, or water) has a characteristic set of properties that gives it its chemical identity. Iron, for example, is a common silver-white metal that melts at 1,535° C, is very malleable, and readily combines with oxygen to form the common substances hematite and magnetite. The detection of iron in a mixture of metals, or in a compound such as magnetite, is a branch of analytical chemistry called qualitative analysis. Measurement of the actual amount of a certain substance in a compound or mixture is termed quantitative analysis. Quantitative analytic measurement has determined, for instance, that iron makes up 72.3 percent, by mass, of magnetite, the mineral commonly seen as black sand along beaches and stream banks. Over the years, chemists have discovered chemical reactions that indicate the presence of such elemental substances by the production of easily visible and identifiable products. Iron can be detected by chemical means if it is present in a sample to an amount of 1 part per million or greater. Some very simple qualitative tests reveal the presence of specific chemical elements in even smaller amounts. The yellow colour imparted to a flame by sodium is visible if the sample being ignited has as little as one-billionth of a gram of sodium. Such analytic tests have allowed chemists to identify the types and amounts of impurities in various substances and to determine the properties of very pure materials. Substances used in common laboratory experiments generally have impurity levels of less than 0.1 percent. For special applications, one can purchase chemicals that have impurities

totalling less than 0.001 percent. The identification of pure substances and the analysis of chemical mixtures enable all other chemical disciplines to flourish.

The importance of analytical chemistry has never been greater than it is today. The demand in modern societies for a variety of safe foods, affordable consumer goods, abundant energy, and labour-saving technologies places a great burden on the environment. All chemical manufacturing produces waste products in addition to the desired substances, and waste disposal has not always been carried out carefully. Disruption of the environment has occurred since the dawn of civilization, and pollution problems have increased with the growth of global population. The techniques of analytical chemistry are relied on heavily to maintain a benign environment. The undesirable substances in water, air, soil, and food must be identified, their point of origin fixed, and safe, economical methods for their removal or neutralization developed. Once the amount of a pollutant deemed to be hazardous has been assessed, it becomes important to detect harmful substances at concentrations well below the danger level. Analytical chemists seek to develop increasingly accurate and sensitive techniques and instruments.

The Importance And Application Of Chemistry

Everything is made of chemicals. Many of the changes we observe in the world around we see that caused by chemical reactions. Chemistry is very important because it helps us to know the composition, structure& changes of matter. All the matters are made up of chemistry. In our every day like various chemical are being used in various from, some of those are being used as food, some of those used clanging etc.

Element in the Human Body

Body is made up of chemical compounds, which are combinations of elements. Probably know body is mostly water, which is hydrogen and oxygen,

Health Care and Beauty

The diagnostic tests carried out in laboratories, the prognostic estimations, medical prescriptions, pills, the vaccines, the antibiotics play very vital role in health monitoring, control of diseases and in alleviating the sufferings of the humanity. Right from birth control to enhancement of life expectancy- all have been made possible using the unequivocal services of Chemistry. From simple sterilization surgical instruments with antiseptic solution to Chemotherapy and Genome sequencing are all nothing but applications of Chemistry. Injecting cows, buffaloes, goat and sheep with bovine some towrope Increases milk-production but it is indiscriminately being used by sportspersons to un-ethically enhance performance. Aging- a chemical change can only be checked chemically. Most beauty products are produced through chemical synthesis to clean, nurture and protect skins. However their certain ingredients are hazardous to our health in the long run.

Industries and Transport

From cloth mills, lather factories, petro-chemical industries and refineries to metal industries-all use numerous fuels for power generation and chemical products for processing their product and improve the equality and simultaneously produce pollution. Now-a-days chemical effluent treatment plants use chemicals to control or neutralist he hazardous impact of pollutants produced by the industries. Aviation and shipping industries generate power through power plants which burn fuels. Petrol and diesel emit out green house gases dangerous for the survival on earth which damage the ozone layer that protects us from UV rays. As a result global warming has taken place which is a destroyer of the planet earth. But again Chemistry paves the way with bio-fuels.

Food Security and Agriculture:

The famous green revolution to increase agricultural produce so as to ensure food security was triggered by the advent of inorganic fertilizers. Since then fertilizers are extensively used by farmers to restore the fertility of soil in the fields. Pesticides are used to protect the crop during farming and preserve the grains from pests, rats and mice during storage. Genetically modified seeds which are used to enhance production and earn profits through export of food grains are agricultural applications of Bio-chemistry. Whereas refrigeration system for cold storage of vegetables and raw meat uses Poly Urethanes Foam (PUF) and the chemical properties of gases, the preservatives in packaged food products are known to have adverse impact on our body.

Science and Technology

The destructive effects of Atom Bombs dropped on Hiroshima and Nagasaki? Generations in Japan have suffered the devastation and there has-been no solace. The threat of weapons of mass-destruction (WMDs) like the Nuclear, Chemical and Biological weapons looms large on the Humanity. Terrorists are using RDX and other explosives to run currents of fear down the spines across the globe. Nuclear reactors which are going to serve the future generations through power generation leave us with the problem of Nuclear Waste Management. Whereas the destructive power is generated through chains of chemical reactions, we remain assured that Chemistry has facilitated the chain of counter measures too in the form of safety suites and NBC resistant bunkers. Forensic science- the comprehensive scientific analysis of material evidence in the context of the law uses principles of chemistry to facilitate crime investigation. Tele-communications, Information Technology and Space Missions- all bank on the chemistry of semi-conductor sand nano-tubes.

1. Chemistry and Medicine

Most drugs are made of organic materials, which is why medicine, understood as a study area, is closely related to organic chemistry. Antibiotics, cancer medication, analgesics and anesthesia are some of the medicines made from organic matter.

2. Chemistry and Food

Food is made of carbon, object of study of organic chemistry. Carbohydrates are the most obvious example of the chemical composition of food. The term itself leads one to think of carbon and hydrogen (in fact, carbohydrates are composed of one molecule of carbon, one of hydrogen, plus one of oxygen - CHO); Proteins (NH2-CH-COOH) and fats (CH-COO-CH) also contain carbon, even vitamins are organic matter.

Through chemistry, you can study the amount of carbohydrates, proteins, fats and vitamins that the human body needs under different conditions. For example, during pregnancy, the Consumption of vitamins (Such as folic acid); While, if it is desired to tone the body, a High protein diet.

3. Chemistry and Sterilizing Agents

Most sterilizing agents, such as phenol and formaldehyde, are composed of carbon, an element studied by organic chemistry (as discussed above). These carbon-based sterilants are effective at removing bacteria and other microbes.

4. Chemistry and Economics

Many of the carbon compounds, such as diamond, graphite and Petroleum Are considered of great value. Diamond and graphite are pure carbon with no other element inside and both have a wide variety of uses and are also highly costly.

For its part, oil is one of the most valuable resources in the world and, economically, is one of the most influential. This can be transformed through various chemical processes to give rise to other resources that humans might need, such as gasoline, tires, among others.

In this sense, the chemistry is very useful in the oil industry, since through this science can develop processes that allow to transform the oil and take this resource to the maximum.

5. Chemistry and Agriculture

Fertilizers are organic or inorganic chemicals that are added to Floors to provide the necessary nutrients for them to be productive. Some studies in the field of agriculture show that the use of commercial fertilizers can increase agricultural production up to 60%. This is why agriculture is now dependent on scientific advances, mainly in the area of chemistry, since they allow production to be optimized.

Fertilizers, both organic and inorganic, maximize agricultural production if used in the right amounts. However, the organic ones present greater concentration of chemical necessary for the growth of the plants.

6. Chemistry and Chemistry

Chemistry coincides with chemistry in the study of structures at the molecular level. Similarly, the principles of chemistry are useful in cell Chemistry because cells are made up of chemicals. At the same time, multiple chemical processes take place within an organism, such as digestion, breathing, Photosynthesis in plants, among others.

In this sense, to understand Chemistry, it is necessary to understand the bases of chemistry, just as to understand chemistry is necessary to know about Chemistry. From the interaction between Chemistry and chemistry, several interdisciplines arise, among which the chemical ecology, biochemistry and biotechnology stand out.

7. Chemistry and Biotechnology

In simple words, biotechnology is technology based on Chemistry. Biotechnology is a broad discipline in which other sciences such as chemistry, microChemistry, genetics, and others interact.

The object of biotechnology is the development of new technologies through the study of biological and chemical processes, organisms and cells and their components. Biotechnology products are useful in a varicty of fields, including agriculture, industry and medicine. Biotechnology is divided into three areas:

- Red biotechnology
- Green biotechnology
- White biotechnology

Red biotechnology includes the uses of this science in relation to medicine, such as the development of vaccines and antibiotics.

Green biotechnology refers to the application of biological techniques in plants, to improve certain aspects of these; Genetically modified (GM) crops are an example of green biotechnology.

Finally, white biotechnology is biotechnology used in industrial processes; this branch proposes the use of cells and organic substances to synthesize and degrade certain materials, instead of using petrochemicals.

2.2 Importance Of Laboratories In Chemistry Education

Laboratory activities have long had a distinctive and central role in the science curriculum and science educators have suggested that many benefits accrue from engaging students in science laboratory activities (Pickering, 1980; Hofstein & Lunetta, 1982; Garnet et al., 1995; Lunetta, 1998; Tobin, 1990; Hofstein & Lunetta, 2004). Since the end of the 19th century, when schools began to teach science systematically, the science laboratory has become a distinctive feature of science education.

During the major curriculum reforms in science education in the early 1960s, practical work in science education was used to engage students in investigations, discoveries, inquiries, and problem-solving activities. In other words, the laboratory became (at least in the minds of science educators and curriculum developers) the center of science teaching and learning. For example, George Pimental editor of the CHEMStudy (summarized by Merril & Ridgway, 1969) suggested that the laboratory was designed to help students gain a better idea of the nature of science and scientific investigation by emphasizing the discovery approach.

In 2004, as this review of my work is being written, we operate in a new era of reform in science education. Both the content and pedagogy of science learning and teaching are being scrutinized, and new standards intended to shape meaningful science education are emerging. The *National Science Education Standards* (National Research Council, 1996) and other science education literature (Lunetta, 1998; Bybee, 2000; Hofstein & Lunetta, 2004) emphasize the importance of rethinking the role and practice of laboratory work in science teaching in general and in the context of chemistry education in particular. It is true that very

often research has failed to show a simplistic relationship between experiences provided to the students in the laboratory and learning science. However, sufficient data do exist to suggest that the laboratory instruction is an effective and efficient teaching medium to attain some of the goals for teaching and learning science. Appropriate laboratory activities can be effective in helping students construct their knowledge (Tobin, 1990; Gunstone, 1991), develop logical and inquiry-type skills, as well as problem-solving abilities. They can also assist in the development of psychomotor skills (manipulative and observational skills). In addition, they have a great potential in promoting positive attitudes and in providing students with opportunities to develop skills regarding cooperation and communication. In this respect the science laboratory is a unique learning environment. Thus, it has the potential to provide science teachers with opportunities to vary their instructional techniques and to avoid a monotonous classroom learning environment.

The review of my research on the laboratory is based on more than 30 years of experience with all facets of the chemistry curriculum in the upper secondary schools in Israel. This included chemistry curriculum development, implementation, evaluation, and research. Throughout the years an attempt has been made to cover most of the domains that characterize practical work in the context of the chemistry laboratory. Among these are studies focusing on the following aspects:

1. The chemistry laboratory: A unique mode of learning, instruction, and assessment.
2. Assessing students' performance and achievement using different modes of presentation in the chemistry laboratory.
3. Students' attitude towards and interest in school chemistry laboratory work.
4. Students' perceptions of the laboratory classroom learning environment.

2.3 Method And Technique Used In Teaching Chemistry

Kelly and Lister (1965), based on comprehensive research findings, suggested that the science laboratory is a unique mode of teaching and learning and that the abilities of students in the laboratory are only slightly correlated with their abilities in other non-practical learning experiences. Support for this was provided at a later stage by Tamir (1972) and more recently by Yeany, Larossa, and Hale (1989). A study on modes of learning and teaching in the context of chemistry was conducted by Ben-Zvi, Hofstein, Samuel, & Kempa (1977). The main goal of this study was to identify relationships between modes of learning in the chemistry laboratory and other modes of learning that prevail in high school chemistry. The study was undertaken in the context of a laboratory centered program: *Chemistry for High School* (1972), developed at the Weizmann Institute of Science. This program was developed and implemented in the Israeli education system to replace the adopted version of the Chemistry Study program. To this end, a battery of tests were developed to cover at least the first three phases of performance in the chemistry laboratory (Kempa & Ward, 1976; Kempa, 1986; Giddings & Hofstein, 1990; Giddings, Hofstein, & Lunetta, 1991): *planning and design* (formulating questions, predicting results, formulating hypotheses, to be tested designing experimental procedures); performance (in conducting an experiment, manipulating materials and equipment, making decisions about investigative techniques, observing and reporting findings); analysis and interpretation (processing data, explaining relationships, developing generalizations, examining the accuracy of data, outlining limitations, formulating new questions based on the investigation conducted); and *application* (making predictions about new situations, formulating hypotheses on the basis of investigative results, applying laboratory techniques to new experimental situations). These phases refer both to psychomotor skills (manipulation and observation) and to cognitive abilities, i.e. investigation and processing of a problem and its solution by practical means.

Researchers, teachers, and testing jurisdictions, whose goal is to assess comprehensively the learning that takes place in school science generally, or in school laboratories more specifically, should use appropriate assessment tools and methodologies to identify what the students are learning (conceptual as well as procedural).

2.4 Chemistry Teachers In Secondary School

A teacher is a person who earns his living through the teaching of others in an organized institution. Since a teacher is formally appointed to teach, then he needs to be certified or show some signs of training, must be knowledgeable trained to know, understand learning process is a teacher Aririabere (1996).

A qualified teacher in this context means a chemistry teacher who posses not only the knowledge of chemistry to impart but also those who has studied the theories of learning and methods of teaching and is professional by his training. Education is the most influential tool whose efficient use requires the power of determination, devoted work and sacrifice. As teachers are major handler of this tool therefore, they must possess qualities of high education and competency for deliver. Education extends attractive way of life, talent and manners which make an individual a fine civilian. Primary and secondary education is one of the foundation stone of development of children and country. It acts as a vital part in placing the proper institution of child's cultural, social, moral, emotional, intellectual, physical and spiritual improvement. Primary education contributes to national development while education at post graduate level provides think tank for progress of country. The Secondary education which serves as a link among primary and higher education is expected to prepare young people between the age group of 14-18 in the world of work, who are ready to enter into advanced education. Chemistry is the basis of life, and subject of importance in nation building, acquiring much attention from the world class Universities now days, to build

interest and skills into the students for complex education. Chemical education is an active area of research within both the disciplines of chemistry and education, focusing on learning and teaching of chemistry in schools, colleges and universities, with the goals of understanding how students learn chemistry, how best to teach chemistry. The curricula of higher secondary education require special attention at theory and practical level which should build the interest and attraction in chemistry in the age of 14-18. There is need of designing new curricula, covering chemistry in an easiest and attractive way associated with the environment1. Organization of continual workshops for teachers for fresh up courses aimed at building awareness in new themes in chemistry education. In chemistry education should consist of understanding, how students learn chemistry, how best to coach chemistry, and how to improve learning outcomes by changing teaching methods. The appropriate training of chemistry lecturer, include much methods, together with classroom lecture, demonstrations, and laboratory experimental activities are essential regularly. There is a constant need to update the skills of teachers engaged in teaching chemistry at secondary level. Kyne3 reported about the teaching system in multigrade classrooms throughout the world which would like to increase in near future. Kyne3 addresses that professional knowledge and skills that are pertinent and compulsory to teaching efficiently in single-grade perspectives are also applicable and essential for effective multigrade teaching. Bodner4 ACS director (Division Chemical Education) emphasize on improvement in K–12 science education which is now a days are increasingly choral as the need for a highly skilled logical employees and a precisely well-educated community has become imperative in the U.S. ACS is increasing its events associated for the training of high school chemistry teachers with the ACS-Hach Programs and CTEC through scholarships for chemistry majors following certification as high school chemistry teachers as well as for second-career chemistry teachers. CTEC's mission is keenly involving chemistry departments in the planning of

future chemistry teachers. ACS is collaborating with NSF, PhysTEC, and APLU to develop a robust CTEC initiative that will increase both the quality and quantity of high school chemistry teachers while catalyzing changes in the culture of teacher education shared by chemistry departments. Holbrook5 Study on Make Chemistry teaching relevant to under grade students showed that chemistry teaching is unpopular and irrelevant in the eyes of students, does not promote higher order thinking talents, leads to gaps between students wishes and teachers teaching is not changing, because teachers are afraid of change and need guidance. He suggested three aspects to understand the issues of relevance of chemistry teaching i) What are we trying to do? ii) How to guide teachers? iii) What could be relevant teaching materials? The teaching of chemistry requires special attention to deliver the subject to student. This must involve several relevant factors, which include teacher competency; syllabus content and its applicability into background; everyday applied work or experiment of chemistry; and the presentation and zeal and zest of the teacher. This need full continues apprises of chemistry teacher with new searches and current contents of chemistry to make chemistry attractive, interesting for selection of the subject by the student in near future. For a high school student's chemistry is most feared & dried subject and can be a bit challenging to handle; when you are talking about chemistry. The teacher has to make sure that the subject is interesting and students can easily appreciate it that we are all enclosed by chemistry and chemical reactions. Those are also taking place inside our own body. A chemistry teacher can easily attract the student by just showing the things around us like how the life depends upon breath and how our body is continuously involve in exchanging of two gasses (CO_2 & O_2) for sustainable life. Name the two important gases and later on tell their function in atmosphere and human. In this way you can tell them that chemistry is not some boring and dull subject but is subject of life. Find out easy-to-do, stimulating trials and get your students to do them in class. Follow these humble methods and tell about other subject to the students

like social sciences, Chemistry physics and engage your class in chemistry is valuable, basic subject of the academia and become the learned, beloved, favored high school teacher.

A qualified teacher is a teacher who has earned credentials from an authoritative source, such as the gov't, a higher education institution or private source. This teachers qualification gives a teacher authorization to teach and grade in pre-schools, primary or secondary education in countries, schools content areas or curricula where authorizing entities require a student teaching before earning teacher certification, routes vary from country to country. A teaching qualification is one of the numbers of academic and professional degrees that enable a person to become a registered teacher. Example of teaching qualification includes the Post-Graduate Certification in Education (PGCE) the Professional Graduate in Education (PGDE), National Certificate in Education (NCE) and the Bachelor of Education through teacher qualification are most commonly provide by government and higher education institutions, there are a few private bodies providing teacher certification; for example the National Board for Professional Teaching standards in the United States for the Center for Teacher Accreditation (CENTA) India.

Aghenta (1980) submitted that the problem associated with inadequacies of qualified teacher in the country is worldwide but more obvious in the developing countries where sufficient provision of qualified teachers. Our educational system, starting with the primary school level, should be such that competent teachers are employed to teach specific based on training. A system where a grade II certificate holder is given a class to teach rather than subject is not good enough for the present set up in our educational industry (Aririabere, 1996).

Benjamin (1970) noted that hundreds of studies have been carried out on the personnel and professional characteristics of teachers in an attempt to stablish which trait are the most desirable for teachers to possess and which are definite handicaps.

The following traits were listed, adaptability, attractive personal appearance, bredth of interest in community, carefulness, accuracy, definiteness, throughmess.

Jatto (1982) in his work on the performance of students' teachers opened that the success of any educational policy in any country depended to a large extent on the quality and caliber of the teachers.

2.5 Student's Attitude Toward Chemistry

Developing favourable attitudes towards science has often been listed as one of the important goals of science teaching. Hofstein and Lunetta (1982, 2004) have suggested that the laboratory, as a unique social setting, has (when activities are organized effectively) great potential in enhancing social interactions that can contribute positively to developing attitudes and cognitive growth. Several studies published in the 1970s and early 1980s (as reviewed by Bates, 1978, and by Hofstein & Lunetta, 1982) reported that students enjoy laboratory work in some courses and that laboratory experiences resulted in positive and improved student *attitudes* and *interest* in science. For example, Ben-Zvi, Hofstein, Samuel, and Kempa (1976b) reported on chemistry students who were asked to rate their perceptions of the relative effectiveness of instructional methods for promoting their interest in and attitude towards learning chemistry. They reported that personal involvement in the chemistry laboratory was the most effective instructional method for promoting their interest in chemistry studies when contrasted with teachers' demonstrations, filmed experiments, classroom discussions, and teacher's lectures. In the previous chapter, Ben-Zvi et al. (1976a) reported that in general, filmed experiments are effective substitutes to students' own

experimentation, in regard to the cognitive, and to a considerable extent, the psychomotor outcomes resulting from them. It is clear from this study that that this does not apply to students' perceptions of the learning approaches and their liking for them.

In addition, in a study in which we explored the reasons for students' enrollment in more advanced (post-compulsory) courses in high-school chemistry, we found that one of the key reasons was their experiences with practical exercises in the chemistry laboratory (Milner, Hofstein, & Ben-Zvi, 1987). These results are in alignment with findings in the USA (Charen, 1966; Johnson, Ryan, & Schroeder, 1974) Also, more recently, in Nigeria, Okebukola (1986) summarized his study, claiming that a greater degree of participation in the science laboratory resulted in an improved attitude towards chemistry learning in general and towards learning in chemistry laboratory in particular. Okebukola (1986) used the *Attitude towards and interest in chemistry laboratory questionnaire* developed and validated by Hofstein, Ben-Zvi, and Samuel (1976) in Israel. This questionnaire was used in a study conducted in Israel (N=505, in 10-12th grades, in 5 schools). Our analysis of students' responses using factor analytic investigation, revealed that students' attitude towards the chemistry laboratory is not one-dimensional, as it was assumed to be for attitudes towards science and school science (Hofstein, Ben-Zvi, Samuel, & Kempa, 1975). The following attitudinal dimensions were obtained: *learning in the science laboratory, the amount of laboratory work*, and *the value of laboratory work*. Importantly, it was found that the measure is sensitive to the type of the experiences to which the students are exposed, to differences in the type of subject that the students learn (Chemistry, chemistry, and physics), and finally to gender differences. For example, it was found that chemistry students in 12th grade (age 17) found laboratory work less stimulating than their 11th and 10th grade counterparts. In addition, a comparison of boys and girls regarding the various attitudinal dimensions revealed no significant differences, unlike previous work in physics learning

berg, 1967), in which it was found that the boys' attitude is significantly more positive. questionnaire was administered more recently in a study in which two groups of students compared (Kipnis & Hofstein, 2003). The first group consisted of students who ormed inquiry-type chemistry experiments (Hofstein, Kipnis, & Shore, 2004), whereas other group comprised students whose laboratories mainly consisted of confirmatory-type eriments. It was found that in general, the students who were involved in the inquiry-type ctical experiences developed a much more positive attitude towards learning chemistry in ieral and towards learning chemistry in a laboratory setting in particular compared to other group (control). At the beginning of the 1990s, the focus of scholarly research in the ience education literature moved away somewhat from the affective domain and moved ore towards the cognitive domain in general and towards conceptual change in particular. wo comprehensive reviews that were published in the early 1990s (Hodson, 1993; azarowitz & Tamir, 1994) did not discuss research focused on affective variables such as ttitudes and interest. Nevertheless, the science education literature continues to emphasize hat laboratory work is an important medium for enhancing attitudes, stimulating interest and enjoyment, and motivating students to learn science in general and chemistry in particular (e.g., Freedman, 1997; Thompson & Soyibo, 2002).

CHAPTER THREE

RESEARCH METHODOLOGY

.1 Introduction

This chapter deals with the steps and methods used by the researchers in carrying out this tudy. The chapter includes description of the research design, population of the study, ample and sampling techniques, instrumentation, validity and reliability of the instrument, method of data collection and procedure for data analysis.

3.2 Research Design

The design for this research work is basically a descriptive survey research which aims at investigating the problems and prospects of teaching chemistry in secondary schools in Gusau metropolis of Zamfara State, Nigeria. Nwogu (2006) viewed survey research as that in which a group of people or items are studied by collecting and analyzing data from only few people or items considered to be the representative of the entire group. He noted that descriptive survey studies aim at collecting data on and describing on a systematic manner the characteristics, features or facts about a given population.

Therefore, this research work was designed to investigate the problems and prospects of teaching chemistry in secondary school in Gusau metropolis of Zamfara state by collecting and analyzing data from selected number of chemistry teachers and students to represent all the chemistry teachers and students of Zamfara state secondary schools.

3.3 Population Of The Study

The population of the study refers to the total number of subjects in the investigation. The population of the research comprised all teachers and students of senior secondary schools

offering chemistry in Zamfara State. According to Zamfara state Ministry of Education, Inspectorate Services Department (2018), there are total numbers of 73 senior secondary schools (40 private and 23 publicly owned senior secondary schools) which are all offering chemistry at senior class 1 to 3.

The students and teachers in this research belong to the tribes of Hausa, Fulani, Yoruba and Igbo. The students are between the ages of 13, 15 to 18 years old (S.S 1, 2 and S.S 3 students) and the teachers have between 5 to 26 years of teaching experience.

3.4 Sample and Sampling Techniques

Sample of a study refers to the selected subjects utilized in the study. It must demonstrate a complete representation of the actual population. Due to the limited time available, insufficient funds and other conditions beyond the researchers control, a simple random procedure was applied and fifteen (15) secondary schools were selected ten and five (10 private and 5 public schools) from the total number of seventy three secondary schools. In each of the secondary schools, three (3) chemistry teachers and ten (10) chemistry students were randomly selected and used for the study. Altogether, we have forty five (45) chemistry teachers and one hundred and fifty (150) chemistry students involved in the study.

The secondary schools selected are shown in the Table below:

Table 1: List of selected secondary schools

S/N	Names of schools	Type of schools	Number of students	Gender
1.	College of Islamic Science, Gusau	Private	10	Mixed
2.	Muslim's Students Society (MSS) Academy	Private	10	Mixed
3.	New Dawn City college (NDCC)	Private	10	Mixed
4.	Lala International Schools	Private	10	Mixed
5.	Zainab International Schools	Private	10	Mixed
6.	Prince International Schools	Private	10	Mixed
7.	Hauwa International Schools	Private	10	Mixed
8.	Institute for Comprehensive Education	Private	10	Mixed
9.	FCET Secondary School	Private	10	Mixed
10.	Habibu Baraden Kaura (H.B.K)	Private	10	Mixed
11.	Special Day Secondary School (Danturai)	Public	10	Male
12.	Janyau Senior Secondary School	Public	10	Male
13.	Government Girls Day Secondary School (Gada Biyu)	Public	10	Female
14.	Government Day Science Secondary School	Public	10	Male
15.	Government Day Secondary School Damba	Public	10	Male

3.5 Research Instrument

The main instrument developed and used for data collections of this research are questionnaires, one for teachers and one for the students, which were administered by the researchers in the selected schools. The teachers' questionnaire has two sections; section A,

containing general information and Section B which contains 18 question items (open ended and closed ended questions). The students' questionnaire also has two sections; section A, containing general information and section B which contains 17 question items (open ended and closed ended questions).

3.6 Validation Of The Instrument

The questionnaires were validated by the project supervisor from the Department of Science education Federal university Gusau, Zamfara state. The researchers observed all the suggestions and corrections made while writing the final copy.

3.7 Reliability Of The Instrument

Reliability indicates the accuracy or precision of the measuring instrument (Norland, 1990). In order to ascertain the reliability of the questionnaires that were developed for the study, pilot test was conducted by collecting data from 20 subjects (for each questionnaire) who were not included in the sample. Using split-half method, a reliability coefficient (alpha) of 0.84 was obtained for teachers' questionnaire and 0.72 for students' questionnaire which are considered acceptable reliability. According to Afolabi (2003), any reliability ranging from 0.5 and above can be taken to be high enough for use.

3.8 Method Of Data Collection

The researchers visited the selected schools and administered the questionnaires to the selected chemistry teachers and students after obtaining permission from the school principals by showing the introduction letters given to the researchers by their Faculty. The respondents were given 45 minutes to fill the questionnaires and the questionnaires were collected back the same day they were distributed.

3.9 Method Of Data Analysis

The questionnaires were administered, collected and analyzed using frequency counts and percentages. Tables were used to illustrate the data collected with interpretation of findings following each table.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter analyzed the responses gathered from teachers and students about the problems and prospects of teaching chemistry in secondary schools in Gusau metropolis, Zamfara state. The results of the data analysis are presented in simple descriptive statistics that is, frequency counts and percentages according to the research questions with interpretation following each table.

4.2 Data Analysis And Interpretation

Table 2: Qualification and professional training of chemistry teachers in Gusau metropolis secondary schools.

S/N	Teachers Qualification	Number of Teachers	Percentage
1	NCE	9	20%
2	B.Sc Ed	4	8.89%
3	B.Sc	22	48.89%
4	HND	8	17.78%
5	M.Sc	2	4.44%
TOTAL		**45**	**100%**

Table 3 reveal that teachers from the sampled schools are; 20% of them have NCE, 8.89% BSc Ed, 48.89% BSc, and 4.44% MSc holders. We can see that by qualification 71.11% are professional teachers but only 28.89% are qualified to teach in senior secondary school level

meaning that qualification can affect teaching learning process, if a teacher is not qualified in teaching he cannot teach well and these can make the student to hate the subject and the teachers.

Research Question 1: What are the problems of teaching chemistry in secondary schools in Gusau metropolis of Zamfara state?

The following Tables were used to answer the research question. The tables were constructed based on the responses of teachers.

Table 3: Frequently Mentioned Problems

S/N	Problems Encountered	Number of teachers	Private school teachers	Public school teachers	Total
1	Insufficient laboratory equipment	45	10	14	24(53.3%)
2	Lack of instructional materials	45	9	15	24(53.3%)
3	Communication	45	7	13	20(44.4%)
4	Lack of student interest	45	15	10	25(55.5%)
5	Student's population	45	8	14	22(48.8%)
6	Lack of separated chemistry laboratory	45	22	14	36(80%)
7	Lack of understanding the terminologies	45	4	6	11(24.4%)
8	Poor background in science	45	8	12	22(48.8%)
9	Lack of library	45	18	14	32(71.1%)

The result in table 3 shows that:

- Twenty four teachers (24) out of forty five teachers (45) making (53.3%) responded that the insufficient supply of laboratory equipments is the problem of teaching chemistry in Gusau secondary schools.
- Twenty four (24) teachers out of forty five (45) teachers making (53.3%) complaint that the lack of instructional materials is among the problem of teaching chemistry in Gusau secondary schools.
- Communication skills is one of the challenges faced by chemistry teachers while delivering the lesson, where twenty (20) teachers out of forty five (45) teachers making (44.4%) show that the communication skills is also one of the problems of teaching chemistry in Gusau secondary schools.
- Twenty five (25) teachers out of forty five (45) teachers making (55.5%) mentioned that lack of student's interest in the subject of chemistry is also among the problems of teaching chemistry in secondary schools of Gusau metropolis.
- Twenty two (22) teachers out of forty five (45) teachers making (48.8%) described that there is also problem of student's population in Gusau secondary schools.
- Thirty six (36) teachers out of forty five (45) teachers making (80%) said that lack of separate chemistry laboratory is also problem of teaching chemistry in Gusau secondary schools.
- Eleven (11) teachers out of forty five (45) teachers making (24.4%) indicate that there is problem of understanding chemistry terminologies from the students in Gusau metropolis secondary schools.
- Twenty two (22) teachers out of forty five (45) teachers making (48.8%) expressed that there is problem of poor background in science among the students of secondary schools in Gusau metropolis.

- Thirty two (32) teachers out of forty five (45) teachers making (71.1%) responded that the lack of library is also among the problems of teaching chemistry in the secondary schools of Gusau metropolis.

Research question 2: Does the problems of teaching chemistry manifest in both public and private schools?

According to table 3 above the problems of teaching chemistry manifest in both public and private schools respectively. Some of the problems like item 1, 4,6 and 9 that is; insufficient laboratory equipment, lack of student interest, lack of separate chemistry laboratory and lack of library respectively, are said to occurred at nearly the same rate in both public and private schools. While problems like item 2,3,5,7,and 8 that is; lack of instructional materials, communication, student's population, lack of understanding the terminologies and poor background in science respectively, occurred at high rate in public schools, and in private schools the rate is very low.

Research question 3: Are the problems of teaching chemistry similar as perceived by teachers and the students?

Table 4: frequently mentioned problems by students

S/N	Frequently Mention Problems	Students (150)
1	Poor teaching method by teachers	105(71%)
2	Insufficient laboratory equipments	120(81.5%)
3	Population of student in the class	128(87%)
4	Lack of interest in the subject matter	98(70%)
5	Lack of library	134(89.5%)
6	Poor background in science	126(83.5%)
7	Lack of separated chemistry laboratory for practical	144(95.5%)
8	Lack of good communication skills	95(63.5%)
9	Lack of qualified teachers	116(76%)

The table 3 and 4 are used to answer this question. From the table three and four (3 and 4) we can deduce that the problems are almost similar as perceive by both teachers and the students. The only difference is that the students face the problem of poor teaching method by the teachers and lack of qualified teachers. As described by the table 4 below

The result in table 4 shows that:

- One hundred and five (105) out of one hundred and fifty students (150) making (71%) responded that poor teaching method by teachers is the problem of teaching chemistry in Gusau secondary schools.
- One hundred and twenty (120) out of one hundred and fifty (150) students making (81.5%) complaint that insufficient laboratory equipments is among the problems of teaching chemistry in Gusau secondary schools.

- One hundred and twenty eight (128) out of one hundred and fifty students making (87%) show that the population of student in the class is also one of the problems of teaching chemistry in Gusau secondary schools.
- Ninety eight (98) out of one hundred and fifty students (150) making (70%) mentioned the lack of student's interest in the subject of chemistry is also among the problems of teaching chemistry in secondary schools of Gusau metropolis.
- One hundred and thirty four (134) out of one hundred and fifty (150) students making (89.5%) described that lack of library is among the problems of teaching chemistry in Gusau secondary schools.
- One hundred and twenty six (126) out of one hundred and fifty (150) students making (83.5%) said that poor background in science is also problem of teaching chemistry in Gusau secondary schools.
- One hundred and forty four (144) out of one hundred and fifty (150%) students making (95.5%) indicated that lack of separate chemistry laboratory for practical is another problem of teaching chemistry in Gusau metropolis secondary schools.
- Ninety five (95) out of one hundred and fifty (150%) students making (63.5%) expressed that there is problem of good communication skills among the students of secondary schools in Gusau metropolis.
- One hundred and sixteen (116) out of one hundred and fifty (150%) students making (76%) responded that the lack of qualified teachers is also among the problems of teaching chemistry in the secondary schools of Gusau metropolis.

The remaining students do not mentioned any of the problems, some of them do not to know what to say and some do not even know how to write.

Research Question 4: Are the problems of teaching chemistry similar as perceived by male and female students?

Table 5: Frequently mentioned problems by male and female students

S/N	Frequently mentioned problems	Frequency	
		Male students(90)	Female students(60)
1	Poor teaching method by teachers	60 (67%)	45 (75%)
2	Insufficient laboratory equipments	65 (72%)	55 (91%)
3	Population of student in the class	70 (78%)	58 (96%)
4	Lack of interest in the subject matter	42 (47)	56 (93%)
5	Lack of library	80 (89%)	54 (90%)
6	Poor background in science	78 (87%)	48 (80%)
7	Lack of separated chemistry laboratory for practical	87 (96%)	57 (95%)
8	Lack of good communication skills	55 (61%)	40 (66%)
9	Lack of qualified teachers	74 (82%)	Table 5 70%)

Table 5 shows most of the problems frequently mentioned by male and female students of Gusau metropolis secondary schools Zamfara state. Thus, the Table can be interpreted as follows;

Sixty seven percent (67%) and seventy five percent (75%) of male and female students respectively mentioned that the poor teaching method by teachers contribute to problem of teaching chemistry in Gusau secondary schools, and also seventy two percent (72%) of male and ninety one percent (91%) of female students perceived insufficient laboratory equipments inadequate as one of the major problems of teaching chemistry in Gusau metropolis secondary schools. Seventy eight percent (78%) of male and 96% of female students stated that there is high population of student in the class rooms, and Fourty seven percent (47%) of male and 93% female students indicated the lack of student interest in the subject matter.

Eighty nine percent (89%) of male and 90% of female students mentioned that there is lack of library in the schools, and also eighty seven percent (87%) of male and 80% of female students expressed that there is poor background in science among the students. Ninety six percent (96%) and 95% of male and female students respectively indicated that there is lack of separate chemistry laboratory. Sixty one percent (61%) of male and 66% of female students mentioned that there is lack of good communication skills. Eighty two percent (82%) of male and 70% of female students said that there is lack of well trained teachers.

The remaining students do not mentioned any of the problems, some of them do not to know what to say and some do not even know how to write.

4.3 Summary of the Major Findings

- Seventy one point one-one percent (71.11%) of the teachers in secondary schools, Gusau metropolis Zamfara state have qualifications but only 28.89% are qualified to teach
- The students are interested in learning chemistry
- Hundred percent (100%) of the schools have chemistry laboratories
- Forty five percent (45%) of the laboratories are not adequately equipped

- Demonstration method is predominantly used by the Gusau metropolis chemistry teachers while other recommended methods were very rare or not used
- Most of the schools have inadequate supply of instructional materials/teaching aids
- Most of the schools have insufficient supply of instructional materials/teaching aids
- The government and school proprietors do not sponsor teachers to attend in-service training, seminars or workshops
- There is in-sufficient relevant chemistry textbooks in the libraries

In view of the foregoing, the following were suggested by the teachers in their responses to the question item 22 as ways to overcome the problems:

- Most of the teachers suggested that, field trips and excursions should be encouraged because, the memories students get as a result of educational trips called "episode memories" help them to retain knowledge for a long period.
- Most of the teachers emphasized that; value of books should be appreciated, and books should be in adequate supply by the government and school proprietors.
- Forty five percent (45%) of the teachers suggested that, there is need for improvisation of instructional materials for effective teaching and learning.
- Forty two percent (42%) of the teachers suggested that, variable reward structures for teachers based on their competence and relevance of their contributions should be encouraged in order to motivate the teachers for more effectiveness and efficiency in the discharge of their academic duties.

4.4 Discussion of the Findings

- Table 3 reveals that there is scarcity of professionally trained chemistry teachers in Gusau metropolis Zamfara state (because it is only 28.89% of them that are professionally trained teachers.

- The findings of this research reveal that, the students are interested in learning chemistry.
- It was also noted that most of the teachers are not applying proper methods of teaching that are in conformity with the teaching of chemistry.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, summary of the whole study was made, conclusions and recommendations were made based on the findings, Problems and prospects of teaching chemistry and suggestions for further studies were also given.

5.2 Summary

This research survey was aimed at investigating the problems and prospects of teaching chemistry in secondary schools in Gusau metropolis Zamfara state, Nigeria. The main instrument used for the collection of data was the questionnaires which were constructed by the researchers for both students and teachers and validated by the project supervisor. The questionnaires were administered by the researchers through personal contact with the respondents, the questionnaires were distributed among the selected subjects across the metropolis and all of them responded. A simple random sampling procedure was applied and 15 secondary schools were selected (10 private and 5 public secondary schools) from Gusau metropolis of Zamfara state. A total number of 45 chemistry teachers and 150 chemistry students were involved in the study. The data was collected and analyzed using simple descriptive statistics that is, frequency counts and percentages. Tables were used to illustrate the data collected from the respondents and the findings were described under each table. The major findings are; scarcity of professionally trained chemistry teachers, inadequately equipped laboratories, lack of student's interest, high population of students, lack of separated chemistry laboratories, lack of libraries are not provided and in-sufficient supply of instructional materials/teaching aids among others.

5.3 Conclusions

High standard of education in Gusau metropolis Zamfara state and Nigeria in general is crucial in this age of globalization. That is, only high quality education, an education that quickly and rapidly responds to the changing needs of the society and the demands of the global realities, guarantees survival and competitiveness. The problems and prospects of teaching chemistry in secondary schools of Gusau metropolis Zamfara state were investigated in this research. Based on the findings of this study, the following conclusions were drawn:

i. There exist some problems in teaching chemistry in Gusau metropolis of Zamfara state secondary schools which include scarcity of professionally trained Chemistry teachers, inadequately equipped laboratories, lack of student interest, high population of students, lack of separated chemistry laboratories, lack of libraries and in-sufficient supply of instructional materials/teaching aids among others.

ii. The problems manifest in both public and privately owned secondary schools in Gusau metropolis, Zamfara state.

iii. The problems are almost similar as perceived by teachers and students of Gusau metropolis, Zamfara state secondary schools, and

iv. There are similarities in perception of the problems between male and female students of Gusau metropolis of Zamfara state secondary schools.

In view of the foregoing, the following were suggested by the teachers in their responses to the question item 22 as ways to overcome the problems:

- Most of the teachers emphasized that; value of books should be appreciated, and books should be in adequate supply by the government and school proprietors.
- Forty five percent (45%) of the teachers suggested that, there is need for improvisation of instructional materials for effective teaching and learning.

- Forty two percent (42%) of the teachers suggested that, variable reward structures for teachers based on their competence and relevance of their contributions should be encouraged in order to motivate the teachers for more effectiveness and efficiency in the discharge of their academic duties.

5.4 Recommendations

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

i. Government and proprietors should provide well-organized laboratories and sufficient instructional materials or teaching aids for effective teaching and learning.

ii. Professionalization of teaching in Nigeria is very essential. Employees should therefore ensure that, only professionally qualified teachers are employed for teaching.

iii. Government and proprietors should sponsor teachers to attend seminars and workshops in order for the teachers to be up to date.

iv. Government and proprietors should create conducive teaching-learning environment.

5.5 Suggestions For Further Studies

This project work investigated the problems and prospects of teaching chemistry in Gusau metropolis secondary schools in Zamfara state. Hence, to develop this study further, other researchers should conduct an investigation/research on topics such as:

- The impact of chemistry practical activities on academic achievement of senior secondary school students
- Effects of teaching methods of chemistry on academic performance of senior secondary school students

- An investigation into the strategies to enhance teaching and learning of chemistry in secondary schools
- The role of motivation teachers in the teaching of chemistry
- The effect of instructional materials/teaching aids on teaching and learning chemistry in secondary schools

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APPENDIX I

Students Questionnaire on the Problems and Prospects of Teaching Chemistry in Secondary School in Gusau Metropolis, Zamfara State Nigeria.

This questionnaire is designed to seek information from students on the problems and prospects of learning chemistry in their school in Gusau Metropolis Zamfara State, Nigeria. Please endeavor to fill this questionnaire and bear in mind that your honest and sincere answer will be treated for research propose only.

SECTION A: GENERAL INFORMATION

1. Type of School — Public or Private
2. Class
3. Gender — Male or Female

SECTION B

4. Are you interested in Chemistry — Yes or No
5. Do you have library in your school — Yes or No
6. If the above answer (5) is Yes, are there relevant Chemistry textbooks in the library? — Yes or No
7. Do you have a separate chemistry laboratory? — Yes or No
8. If Yes (in 7 above) is the laboratory well equipped? — Yes or No
9. How often do you conduct practical's?
   i. Once in a week ii. Once in a month iii. Once in term
10. How are the practical's conducted?
    i. Individually ii. In groups iii. By the teacher only
11. Which method is mostly used by Chemistry teachers?
    i. Lecture method ii. Demonstration iii. Practical method
12. Do your Chemistry teachers always cover their scheme of works before examinations? — Yes or No
13. How many times do you offer Chemistry in a week?
    i. Two times ii. Three times iii. Four times
14. How often are you given assignment?
    i. After each topic ii. Weekly iii. Monthly iv. None

15. Do you have time to study your Chemistry note books prior to the next Chemistry lesson? Yes or No

16. How often you read at home?

i. Daily ii. Twice in a week iii. Only on weekend

17. Do your parents encourage you to read at home? Yes or No

18. From your syllabus which topics do your find difficult to understand/study?

a. _____ b. _____

c. _____ d. _____

19. Why is/are the topics difficult to understand/study?

_____

20. How can the difficulty be eliminated _____

APPENDIX II

Teachers Questionnaire on the problems and prospects of teaching Chemistry in Secondary School in Gusau Metropolis, Zamfara State Nigeria.

This questionnaire is designed to seek information from teachers on the problems and prospects of teaching chemistry in secondary school in Gusau Metropolis Zamfara State, Nigeria. Please endeavor to fill this questionnaire and bear in mind that your honest and sincere answer will be treated for research propose only.

SECTION A: GENERAL INFORMATION

1. Types of School: Public or Private _____
2. Qualification: _____
3. Area of Specialization: _____
4. Length of teaching experience: _____

SECTION B

5. How can you rate students readiness to learn chemistry?
   i. Very ready ii. Ready iii. Not ready
6. Which teaching method do you often use in teaching chemistry _____
7. What difficulty do you have in teaching chemistry?
   a. _____ d. _____
   b. _____ e. _____
   c. _____ f. _____
8. How many textbooks do you have access to in preparing your lessons
9. Does the school have a library? Yes or No
10. Are there relevant chemistry textbooks in the library? Yes or No
11. Are the students having access to the textbooks? Yes or No
12. Do you have a separate chemistry laboratory? Yes or No
13. Are there adequate equipments in the laboratory? Yes or No
14. How many time do you take practical lessons in the laboratory
    i. Once in a week ii. Once in a month iii. Once in a term
15. How often do you give assignment to the students?

16. Do the students attempt the assignment?

i. Regularly ii. Sometimes iii. They do not

17. How can you access the performance of your students in chemistry?

i. High ii. Average iii. Low

18. From your syllabus, which topic(s) do you find difficult to teach?

19. Why is / are the topics difficult to teach?

20. How can we eliminate the difficulties?

21. What are other problems you are facing in teaching chemistry?

22. What are the solutions to the problems mentioned?

Department of Science Education,
Federal University Gusau,
Zamfara State.

o Whom it may
Concern.

Sir/Ma,

LETTER OF INTRODUCTION

write to introduce to you Ashiru Abdullahi with Admission o. 1410110070 who is a student of the above department undertaking is/her research work. Please render any assistance to him/her as required.

anks

urs faithfully

FEDERAL UNIVERSITY GUSAU DEPARTMENT OF SCIENCE EDUCATION. SIGN ___ DATE ___

Suleiman Bashir

ad of Department