AVAILABILITY OF LABORATORY RESOURCES FOR CONDUCTING BIOLOGY PRACTICALS IN SECONDARY SCHOOLS IN MINNA METROPOLIS, NIGER STATE

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A PROJECT SUBMITTED TO THE DEPARTMENT OF SCIENCE EDUCATION, SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA. IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B. TECH) IN SCIENCE EDUCATION WITH BIOLOGY OPTION

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ABSTRACT

Science has been considered as the bedrock upon which the modern day technological breakthrough is built and to achieve this, the inculcations of the scientific principles demands the initiation of a child right from the early stage of life. All scientific research and experiments are done in the laboratory. Laboratory is seen as a room equipped for scientific research. Many secondary schools are not measuring up to standard of the required resources in the laboratory, thus this study which is concerned with the assessment of laboratory resources for conducting biology practicals in secondary schools in Minna metropolis, Niger state tends to find out the availability, adequacy, functionality and maintenance of biology laboratory resources. The study adopted a descriptive survey research method which used questionnaire as instrument for data collection. Five specific objectives and five research questions were raised to help the study. Literatures were reviewed under conceptual frame work, theoretical work and empirical studies. The population of the study comprised of biology teachers in Nigeria and the target population comprised of all the 81 biology teachers in the 23 public secondary schools in Minna metropolis made up of Bosso and Chanchaga local government. The sample size of this study comprised of 69 biology teachers which was determined using Morgan's Table and thus three respondents were selected each representing a school. A structured questionnaire was used for data collection is divided into six (6) sections and comprised of138 items. The instrument was validated by four experts and trial tested for reliability. Data were analyzed using frequency and percentage table. The result of the findings indicated that there are biology laboratories in public secondary schools in Minna metropolis. Biology laboratory resources are available for conducting biology practicals in Minna metropolis, though modern laboratory resources like incubator, drying oven, projector, refrigerator, and autoclave are not available. The study also revealed that the laboratory facilities available are adequate, functional and maintained in public secondary schools in Minna metropolis. There is no proper repair of damaged materials, no replacement of damaged materials, no training of staff and students, no payment of laboratory dues and there is no award giving to deserving staff and students. Recommendations and suggestions were made for further studies.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Science is seen as the systematic study of nature. It has also been considered as the bedrock upon which the modern day technological breakthrough is built (Akor, 2017). The world is advancing technologically and to attain the advancement, the need for training of manpower resources becomes a vital issue. Science education is the inculcation or impartation of scientific knowledge and understanding unto someone who is traditionally not scientific oriented. Science education aims at the development of scientific literacy and the inculcation of scientific values in the minds of the citizens (Gana & Mogbo, 2014). They further stated that the aims could be simply put as acquisition of scientific literacy, development of scientific attitudes and acquisition of scientific skills. This aims also go inline with the national objectives of education. The scientific literacy which inculcates the power of careful observation, classification and interpretation of observed phenomena can be initiated in the early stage of students' academic pursuit (Ukaegbu, 2012).

Secondary school is the base in preparing students for science education. It is the phase of academic level after primary school. It is also an intermediate school between elementary school and tertiary institution. A secondary school is both an organization that provides secondary education and the building where this take place (wikipepedia, 2006). The importance of secondary education in educational system cannot be overemphasized. Apart from serving as the link between primary and tertiary education, it provides opportunity for a child to acquire educational knowledge, skills and traits beyond the primary level (Ige, 2012). The national policy on education deemed it necessary and thus included science education in the secondary school curriculum to

ensure the early build up of manpower resources needed for the technological advancement which comes through the impartation of science oriented subjects in the secondary schools (Federal Republic of Nigeria, 2004). The core science subjects in secondary schools include physics, chemistry and biology.

Biology has been considered as the branch of science that is concerned with careful and systematic study of life. The word biology is derived from two Greek words: ‘’bio’’ meaning life and ‘’logos’’ meaning study; thus, the study of living things. The study of biology ranges from unicellular molecules to biosphere encompassing the earth’s surface and the living organisms within (Sarojini & Ramalingan, 2007). Biology as a natural science deals with the study of life and living organisms including their structures, distribution and economy. The knowledge of biological sciences have resulted in the production of manpower resources in many fields such as in food production through genetic engineering, fertilizer application, and insecticides and pesticides; in medicine through manufacturing of drugs for curing deadly diseases; food processing and storage; animal husbandry through improve species; crop improvement with good qualities by the plant breeders; amongst others. Science has progressed by breaking down complex subject of study into their component parts so that today there are numerous branches of biology such as anatomy dealing with gross structure, physiology dealing with gross function, histology dealing with tissues, cell biology dealing with cells, biochemistry and molecular biology dealing with molecules, genetics concern with inheritance, zoology dealing with animals, botany concern with plants and microbiology concern with microorganisms (Green, Stout and Taylor, 2005).

Biology education involves teaching of biological sciences in all levels of educational systems. Teaching involves the build up of the three domains which are affective domain, psychomotor domain and cognitive domain with respect to feelings,

remembering and recalling respectively i.e Blooms taxonomy (Gana & Mogbo, 2014). For this to be achieved, the teaching and learning of biological science has to be done with both theoretical and well organized practicals.

Biology practical is a collection of experiments that demonstrate biological concepts and processes (Edson & Lwazi, 2017). Hofstein and Lunetta (2004) suggested that learning science (biology) is enhanced and the understanding level is improved when students are involved in carefully organized laboratory practical experiments. It is also believed by most educators and scientists that participating in laboratory practical experiments would help students learn methods of accurate observation and inductive reasoning. Students are expected to simply absorb the method of inductive reasoning by carrying out experiments according to prescribed procedures (Rudolph, 2005).

Laboratory work is described "at best a very artificial means of supplying experiences upon which to build physical concepts" (Edson & Lwazi, 2017). They further stated that Practical experiments help students' retention ability and keep them improving in learning if carefully and well organized and that in teaching and learning of biology, the teacher and learners are expected to adopt inquiry techniques (laboratory method). Inquiry is the process in which learners do something on their own with their own hands and their own minds (Hornby, 2006). Hornby further opined that inquiry is the art of exploring and experimenting and that the emphasis on involvement of learners in experimentation and problem solving activities help them individual learner an autonomous individual capable of coping with demand of life. This demand for practical activities at all stages of biology teachings to enable students acquires and master practical skills and experiments. This goes hand in hand with the modern educational thinking and practices which places great emphasis on the value of experience in the educational processes. This means having learners to see, hear, touch,

test, make, try and do. This is because what is seen, heard, touched, tested and smelt form an experience that leads to permanent learning if carefully and well organized. The teaching of biology practical is normally carried out in a room called biology laboratory.

Biology Laboratory is a facility that provides controlled condition in which scientific or technological research, experiment and measurement may be performed. Abrahams & Millar, (2008) see it as a room or building prepared and equipped for practical works or a place where practical activities are carried out. Seweje (2000) sees laboratory as the scientists' workshops where practical activities are conducted to enhance a meaningful learning of science concepts and theories. This opinion was also supported by Olubor and Unyimadu (2001). It was also considered by Ige (2000) as central to teaching of science subjects. Ogunleye (2002) asserted that laboratory work it is the primary vehicle for promoting scientific reasoning skills and students understanding thereby enhancing desired learning outcomes in students. Involvement of students in laboratory experiments improves their learning outcome which is seen as the immediate result of the system's activities (Nwadiani 2000). Laboratory works involves the observation and manipulation of subjects in the laboratory using equipment to achieve the desired goals (Millar, 2009). He (Millar) further stated that biology laboratory is expected to be supplied with human and equipments for conducting practicals. This is referred to as biology laboratory resources.

Generally, resources refer to things available and used to meet one's need. Hornby (2006) attested that resources are things that a country, organization or individual has and can use especially to create wealth. Nweke (2000) refers to resources as human, financial and materials available in institution or organization which is used as inputs in production. It is the human and material resources used for production. When these resources are connected to the teaching and learning of practical skills in the laboratory

for intellectual development, it is termed laboratory resources. Biology laboratory resources therefore refers to supplies of teachers, learners, laboratory assistants/technologists, instructional materials and other necessary devices provided to the school to increase wealth of knowledge which give help, support or comfort when the need is appropriately implemented. Biology laboratory resources had been classified into two; human and material resources (Ukaegbu, 2012).

Biology laboratory human resources include human beings or resourceful individuals who in one way or the other help in the effective utilization of material biology laboratory resources. These human resources include teachers, learners, laboratory assistants/technologists, resource persons and other non professional personnel while biology laboratory material resources on the other hand bears other educational names such as instructional materials, teaching materials, educational media, teaching aids, instructional facilities and instructional media (Okoli & Osuafor, 2010). Himezie, Ike and Iwu (2002) referred to teaching materials as devices which present a complete body of information and largely self supporting rather than supplement in teaching and learning processes. Educational material resources are those things which are manipulated, seen, heard, read or talked about and instruments which facilitate such activities. Biology laboratory material resources includes microscope, simple hand lens, dissecting kits, dissecting trays, brush, spatula, dropper, loop, slides, cover slips, Petri dishes, incubators, autoclaves, beakers, funnel, pipettes, Bunsen burner, filter papers, various animal skeletons. It also includes textbooks, marker/chalkboards, models/mock ups, projectors, graphics, and others.

Practical activities using sufficient facilities enable learners to acquire cognitive skills such as formulation of hypothesis, making assumptions, designing investigations, understanding variables, observing, recording data, etc. which are necessary for

engaging in faithful science investigation (Uyoata, 2006). Despite the innumerable importance of laboratory resources for teaching biology practical, many secondary schools are not measuring up to standard in the provision of these resources (Dehar, 2011). This therefore calls for assessment.

Assessment is the systematic process of documenting and using empirical data on the knowledge, skill, attitudes and beliefs to refine and improve its purpose. It is the development and utilization of range of techniques for systematically appraising an individual or group of individuals (Okpanachi, Ejigbo & Omede, 2010). They further stated the techniques for assessment to include the use of tests, interviews, observations, amongst others. Linking this to biology laboratory resources, it is the development and utilization of techniques for systematically appraising the value, worth and importance of resources in the biology laboratory. This research focuses specifically on assessing the availability and utilization of biology laboratory resources in the public secondary schools in Minna metropolis so as to provide recommendations for improvement where necessary.

1.2 Statement of the Problem

Teaching a science oriented subject like biology involves theoretical and carefully organized laboratory practicals in order to meet with modern day educational school of thoughts. Students learn better when they see, hear, touch, test, make, try and do. This is because what students learn by doing and the use of all the sense organs thus bring about permanent learning. To achieve this, the knowledge of laboratory practical comes into play.

Practical laboratory works equips learners with a firsthand knowledge and understanding of the concepts in biology. To facilitate this, resources which are both

human resources like biology teachers, laboratory attendants/technologists, resource persons and biology laboratory material resources like laboratory, animal skeletons, bones from different animals, preserved specimens, dissecting kits, microscope, chemicals, projectors, incubators, autoclaves, amongst others are required in secondary school biology laboratories. Many secondary schools are not measuring up to the standard of this biology laboratory resources both in quality and quantity (Alebiosu, 2000). Where the standard is achieved, utilization becomes another bottleneck **(**Anyadiegwu, 2018). In other case, many available resources are obsolete which needs to be assessed, weed off and replaced but no attention had been given to it. Continual usage of these obsolete materials results in errors to laboratory experiments. Again, most laboratory resources are not well maintained in secondary schools. Careless handling of the laboratory resources result in their wearing away and reduction of their life span (Onipede, 2003).

Many works had been done in favor of laboratory and its resources in different areas using different study techniques but no special attention had been given to checking and documentation of the resources in the biology laboratories. It is on this note that the study titled Assessment of Laboratory Resources for Conducting Biology Practicals in Public Secondary Schools in Minna Metropolis sought to find out the availability, sufficiency, functionality and maintenance of resources in biology laboratories.

1.3 Aim and Objectives of the Study

This study aimed at Assessment of Laboratory Resources for Conducting Biology Practicals in Public Secondary Schools in Minna Metropolis, Niger State. Specifically the study intends to:

1. Examine whether there is biology laboratory in public secondary schools in Minna metropolis.
2. Determine whether laboratory resources for conducting biology practicals are available in public secondary schools in Minna metropolis.
3. Evaluate whether the biology laboratory resources available is sufficient for conducting biology practicals in public secondary schools in Minna metropolis.
4. Investigate whether the biology laboratory resources available are functional for conducting biology practials in public secondary shools in Minna metropolis.
5. Assess whether the biology laboratory resources in the public secondary schools in Minna metropolis are well maintained.

1.4 Research Questions

For the purpose of this study on the assessment of laboratory resources for conducting biology practical in public secondary schools in Minna metropolis, the following research questions were raised to guide the study:

1. Is there biology laboratory for conducting biology practicals in public secondary schools in Minna metropolis?
2. What laboratory resources are available for conducting biology practicals in public secondary schools in Minna metropolis?
3. To what extent are these biology laboratory resources provided for in public secondary schools in Minna metropolis?
4. To what extent are biology laboratory resources functional in public secondary schools in Minna metropolis?
5. Are biology laboratory resources effectively maintained in public secondary schools in Minna metropolis?

1.5 Significance of the Study

The study which is concerned with the assessment of laboratory resources for conducting biology practical in secondary schools in Minna metropolis is expected to be of great importance to science teachers, science students, school administrators, ministry of education, federal government, non governmental organizations (NGOs), international organizations and other researchers.

Through assessment of this work by science teachers, the findings therein will help them with information they need to enrich their teaching through effective combination of laboratory practicals with theoretical teachings thereby making lesson interesting.

To the students, the findings will help them to be aware of the tasks ahead of them in the study of biology so as to corporate with the teacher in involving in laboratory activities to bring about mastery of the concerned subject.

To the school administrators, through proprietory innovative seminars and workshops, the findings will help them on the need for laboratories in secondary school so as to enhance the teaching and learning through laboratory practical skills and for improvement of their educational industry.

To the ministry of education, federal government, non governmental organizations (NGOs) and international organizations, the findings will help them on the need to improve the laboratory resources which go a long way in the production of manpower resources needed for the national development through seminars, workshops, conferences and other forms of public lectures.

The findings are also expected to be useful to other researcher who wants to embark on same study to adopt same method or as source of reference material. The recommendations will also help them on areas needed for further studies.

1.6 Scope of the Study

The scope of this study is Availability of Laboratory Resources for Conducting Biology Practicals in Secondary Schools in Minna metropolis. Geographically, the study covers public secondary schools in Minna metropolis. Minna metropolis is in Niger State, Middle Belt Nigeria. Minna metropolis is made up of two local government areas: Bosso and Chanchaga local government areas. There are a total of twenty three public secondary schools in Minna metropolis: thirteen in Bosso and ten in Chanchaga. It is thus delimited to the assessment of biology laboratory resources in public secondary schools in Minna metropolis, in 2019/2020 academic session.

1.7 Operational Definition of Terms

Assessment: This is the development and utilization of range of techniques for systematic appraisal of something.

Assessment of laboratory resources: The process of taking inventory record of available items/things plus humans in the laboratory.

Biology: The study of living things and their interactions with the environment.

Biology Education: this is the process of imparting the knowledge of biology unto learners.

Biology Practical: The process of seeing for real the existence of things in their natural form.

Laboratory: A room or building prepared and equip for carrying out practical activities.

Laboratory Resources: the available items and humans in the laboratory for effective practical works.

Secondary School: The level of education immediately after primary education and before tertiary institution.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

This chapter presents review of studies relevant to this study. The review is arranged under conceptual framework, theoretical framework, review of empirical studies and summary of literature reviews

2.1 Conceptual Framework

2.1.1 The concept of Biology

Biology is a branch of science that is concerned with the study of life and the interaction between living things and their environments. Biology is the science that studies life (Fowler, Roush & Wise, 2013). It is also considered by Okwo and Tartiyus (2004) as a natural science subject that deals with contents from microscopic organisms to the biosphere in general, encompassing the earth's surface and all living things. Science Teacher's Association of Nigeria (STAN) (2012) stated that biology is a subject consisting of contents from microscopic organisms to the biosphere in general, encompassing the earth surface and all living things. Fowler, *et'al* (2013) posed a question on what life really is. There are nine major characteristics of living things that qualifies life. These are growth, respiration, interaction, movement, nutrition, excretion (Waste), reproduction, Cells (Made of) and death (Taylor, Green & Stout, 2005).

2.1.2 Branches of Biology

There are many branches of biology. These branches came about as result of the specialization of the various fields of biology. Mahmud and Timothy (2012) categorized biology into Zoology which is the study of animals, botany as the study plants, microbiology as the study of microorganisms such as virus, bacteria and fungi, entomology as the study is insects, genetics as the science of heredity and variation,

evolution concerned with the gradual and the continuous process through which the existing species of plants and animals have been produced through previously existing ones, ecology dealing with the study of the interactions between organisms and their environment, biochemistry as the study of the chemical composition of living things, bacteriology as the study of bacteria and virology dealing with the study of virus. The branches of biology today is so vast such that the list is almost inexhaustible, hence, the above are just the few ones.

2.1.3 Biology Education

The need for impartation of scientific knowledge is important hence, quest for knowledge has no limitations. This goes hand in hand with the transfer of knowledge in biology from experienced personnel to others who are not experienced. Eze (1999) as cited by Ukaegbu (2012), biology education is a deliberate transfer of skills, dispositions, knowledge, habits, attitudes, values and norms to prospective teachers. It is seen as the inculcation of biological experiences by a trained expert unto learners who are believed to have not acquired the experiences. The goal of biology education is to develop scientifically literate citizens who can logically think and act rationally, whose goal is to transmit the same value to the next generation through teaching. On a general note, there are two dimensional aims of biology educations which are to serve individual and to serve the society. Biology education achieves its individual and societal roles through the inculcation of the right type of values and attitudes for the survival of both the individual and the society (Ukaegbu, 2012). It was further stated that the acquisition of appropriate skills, abilities and competences by utilizing laboratory resources would go a long way in enabling the students to contribute to the societal development.

Onimisi (2006) stated that the objectives of biology education are aimed at enabling the students who are adequately trained to acquire the following skills:

> *Observing carefully and thoroughly, drawing and labeling accurately observed materials, reporting completely and accurately what is observed, organizing information acquired by the above processes, generalizing on the basis of the acquired information, predicting as a result of this generalizations, designing experiments (including control where necessary), using models or other resource material to explain phenomena where appropriate; and continue the process of inquiry where new data do not form prediction.*

Noting from the objectives above, a trained biology student or teacher is invariably a scientist since all the scientific processes (state the problem, gather information, form hypothesis, perform experiments, analyze data, draw conclusions, form theories and laws) are orderly performed in the laboratory. It will be impossible to achieve if the resources required in the laboratory are inadequately supplied and utilized (Akambi, 2008*).*

Biology as important part of human activity is important to man and the society. Maduabum (1992) as cited by Ukaegbu (2012) opined that the usefulness of biology to man includes helping an individual to understand himself, the parts of his body and their functions; to bring into focus the need to maintain good health such as clean water, clean air, good sanitation, vaccination against infectious diseases, exercise, adequate rest and balanced diets; enable the individual to question superstitions due to sustained interest from a comprehension of the causes of events; promote understanding of the relation of man to his environment; to prepares an individual for higher education; increase an individual's interest and aesthetic appreciation of nature; prepares an individual for vocational selection such as dentist medicine, teaching, agriculture, and many others; inculcates scientific attitudes and skills in solving personal and social

problems; stimulates interest in biologically based hobbies such as growing flowers, collecting insects; etc. thereby encouraging leisure activity for individual enjoyment, and improves the individual factual knowledge and stimulates scientific reflective thinking so as to produce a better informed individual. Biology education also have contributed greatly to the development of the society through control of diseases, environmental conservation, control of human population, human genetics as well as control of alcohol, smoking and drug addition. Same source stressed that if not for the introduction of biology education, human race could have been affected negatively by the above stated factors.

2.1.4 Biology Laboratory

Research and experimental activities are carried out daily by researchers or scientists which help in facilitating response to quest for knowledge. There is a need for conducive, quiet and controlled environment where tools and equipments needed for the study are usually provided for the purpose to be achieved. This place is termed laboratory (Tan, 2008). It was further stated by Tan that laboratory is a facility that provides controlled conditions in which scientific or technological research, experiments and studies are usually carried out. Muhammad (2017) sees laboratory as a place where practical activities are planned and carried out. It was further stated that the laboratory is a work place for the science teachers and researchers and that it contains the resources, apparatus and equipments for science teachings ranging from easily consumable supplies to full range of facilities needed for effective teaching and learning of sciences. Biology laboratory is a modern research infrastructure providing a broad range of biological and biochemical techniques with indebt practical training offered by experienced staff. Important routine work is on microbial and molecular analysis and biological sample preparation in general (wikibook.org.general biology, 2013).

Students and teachers are expected to carryout practical laboratory work in the laboratory (Hofstein, 2004; Hofstein & Lunetta, 2007). Blosser (1990) in Getachew & Harrison (2016) opined that laboratory practical work uses a primary means of instruction in science. Harrison further stated that to equip students with practical skills important for their further career, laboratories should be efficiently used by teachers, and students and teachers themselves should possess those skills. On this account, Psillos and Neidderer (2002) opined that considering the process of developing and evaluation of laboratory, task is important such as teachers, objectives and task design are influenced by teachers' views about science laboratory learning and practicals; institutional factors such as the resources available, the requirement of the curriculum, its mode of assessment and so on.

2.1.5 Biology Laboratory practical

Laboratory work is one of the forms of independent practical work for students in higher, specialized and general schools. Gettachew and Harrison (2016) define practical work as the study of natural phenomena by observation and experiments in the laboratory. They further described laboratory practical as a task which requires some manipulation of apparatus or some actions on materials and which involves direct experiences of the examinee with the material or event at hand. Biology laboratory activities include laboratory demonstrations, hand on activities and experimental investigations (Hofstein & Lunetta, 2004). Laboratory practicals can create a learning environment that encourages students to questions that result in critical thinking. Students are often encouraged to work in small groups leading to social interactions and peer teaching. In addition, through laboratory practicals students will gain technical skills and are often offered access to modern technologies. Gettachew and Harrison (2016) opined that laboratory work is an active process which requires students to be

involved in the observing or manipulating real objects and materials. They further said that laboratory practicals play a distinctive and central role for the development of students' understanding of scientific concepts, improvement of their cognitive skills as well as for the development of positive attitudes. Varieties of terms had been used by researchers and scientists to describe science practical works. Hiba, Heather & Ziab (2014) stated that the various terms synonymous to science practical include practical and inquiry skills, practical and investigative activities, independent inquiry and experimental work.

As opined by Dillon (2008), practical and inquiry skills include any learning experiences in which students interact with materials or secondary sources of data to observe and understand the natural world. Miller (2004) in his own view stated that practical and inquiry skill is any teaching and learning activities which at some points involves the students in observing or manipulating the objects and materials they are studying and that science practicals can take place even outside the laboratory facility hence, location is not a major feature in characterizing this kind of activity. The observation or manipulation of objects might takes place in a school laboratory, but could also occur in out-of-school settings such as the students' home or in the field, for example, in studying aspect of biology. The British Science Community Representing Science Education (SCORE) (2006) sees science practical in science education as the activities in which students observe, investigates and develop an understanding of the world around them through direct, often a first-hand experience of phenomena.

Again, scientific inquiry refers to the diverse ways in which scientists study the natural world and proposes explanations based on the evidence derived from the experiments which help in developing students' knowledge and understanding of scientific ideas as well as an understanding of how scientists study the natural world. For students to

develop the ability that characterized science as inquiry, Hiba *et'al* (2014) suggested that they must actually use the cognitive and manipulative skills associated with the formulation of scientific explanations. Inquiry-type of laboratory provides an exemplar for enacting inquiry-based science classrooms through providing a context for students to experience authentic scientific inquiry. Inquiry-type laboratories have the potentials to develop students' abilities and skills such as posing scientifically oriented questions, forming hypothesis, designing and conducting scientific investigations, formulating and revising scientific explanations and communicating and defending scientific arguments (Hofstein & Manlok-Naaman, 2007).

2.1.6 Objectives of Laboratory Practicals

Hiba *et'al* (2012) recognized the objectives of biological science practicals to include helping students improve their understanding of science, scientific inquiry, development of practical skills in the use of equipment and devices, develop practical skills for better understanding through first hand experience, demonstrate the principles covered in the theory, develop observational skills in the form of identifying and locating desired parts of specimen, develop manipulative skills in arranging and handling the apparatus and instruments and taking readings on them, collect material and to mount it and to develop skill in preserving biological materials and specimens and draw, label and record experimental results and interpret them.

2.1.7 History of Laboratory

Lowe (2015) narrated the origin of laboratory that the early instances of laboratories recorded in English involved in alchemy and the preparation of medicines. The emergence of big science during World War II increased the size of laboratories and scientific equipments, introducing accelerators and similar devices. The earliest

laboratory according to the present evidence is the home of Pythagoras of Samos, the well known Greek philosophers and Scientist. This laboratory was created when Pythagoras conducted an experiment about tones of sound and vibration of string. In the painting of Luis Pasture by Albert Edelfelt in 1885, Luis Pasture is shown comparing a note in his left hand with a battle field with solid in his right hand, and not wearing any personal protective equipment. Researching in teams started in the 19th century, and many new kinds of equipments were developed in the 20th century. A 16th century underground alchemical laboratory was accidentally discovered in the year 2002. Rudolf II, Holy Roman Emperor was believed to be the owner. The laboratory was called Speculum Alchemiae and is preserved as museum in Prague.

2.1.8 Laboratory Techniques and Laboratory Equipment

Laboratory techniques are the set of procedures used on the natural sciences such as chemistry, biology and physics to conduct an experiment (Fritzshe, 2017). It was further stated by same source that all sciences follow the same scientific methods; while some of them involves the use of complex laboratory equipment from laboratory glassware to electrical devices, others require more specific or expensive supplies.

Laboratory equipment on the other hands refers to the various tools and other material resources used by scientists working in the laboratory. Carlson (2013) stated that the classical equipment includes tools such as Bunsen burners and microscope as well as operant conditioning chambers, spectrophotometers and calorimeters. It was further stated that biology laboratory involving chemicals uses laboratory glassware such as the beakers or reagent bottles, analytical devices as HPLC or spectrophotometers. Molecular biology laboratory and life science laboratories uses autoclaves, microscopes, centrifuges, shakers and mixers, pipette, thermal cyclers (PCR), photometer,

refrigerators and freezers, universal testing machine, ULT freezers, incubators, biological safety cabinets, sequencing instruments, fume hoods, environmental chamber, humidifier, weighing scale, reagents, pipette's tips' polymer, and so on. Laboratory equipment is either used in performing experiment or to take measurement and gather data. Larger or more sophisticated equipment is generally called scientific instrument.

2.1.9 Safety in the Laboratory

In many laboratories, hazards are present. Laboratory hazards involves anything capable of causing harm or discomfort to human and poses challenges to health. This includes poisons, infectious agents, flammable, explosive or radioactive materials, moving machinery, extreme temperatures, lasers, strong magnetic fields or high voltage (Micheal, Geffrey & Fitzgerald, 2017). To prevent the occurrence of the above, safety precautions are vital. Rules exist to minimize the individual's risk, and safety equipment to protect laboratory users from injury or to assist in responding to an emergency. The Occupational Safety and Health Administration (OSHA) in the United States recognizing the unique characteristics of the laboratory workplace, has tailored a standard for occupational exposure to hazardous chemicals in the laboratories. This standard is often referred to as the "Laboratory Standard" (Lowe, 2015). Under this standard, a laboratory is required to produce a Chemical Hygiene Plan (CHP) which addresses the specific hazards found in its location and its approach to them.

In determining the proper chemical hygiene plan for a particular business or laboratory, it is necessary to understand the requirement of the standard evaluation of the current safety, health and the environmental practices and assessment of the hazards. The chemical hazard plan (CHP) must be reviewed manually. Many schools and business

employ Safety, Health and Environmental specialists such as Chemical Hygiene Officer (CHO) to develop, manage and evaluate their chemical hazard plan (CHP) (Micheal, Geffrey & Fitzgerald, 2017). They further stated that third party review is also used to provide an objective "outside view" which provide a fresh look at area and problems that maybe taken for granted or overlooked due to habit.

Inspections and audits-like also be conducted on a regular basis due to chemical handling and storage, electrical equipment, biohazards, hazardous waste management, chemical wastes, housekeeping and emergency preparedness, radiation safety ventilation as well as respiratory testing and indoor air quality. SCORE (2006) asserted that an important element of such audits is the review of regulatory compliance and the training of individuals who have access to and/or work in the laboratory. It was further stated that training is critical to the ongoing operation of the laboratory facility. Educators, staff and the management must be engaged in working to reduce the likelihood of accidents, injuries and potential litigation. Efforts are made to ensure laboratory safety materials are both relevant and engaging.

2.1.10 Organization and Design of Biology Laboratory

Organization of biology laboratory refers to ways in which biology laboratory is planned and designed to suit the purpose for which it's meant for. Latour (2003) asserted that scientists consider how their work should be organized, which could be based in themes, teams, projects or fields of expertise. Work is divided, not only between different jobs of the laboratory such as the researchers, engineers and technicians but also in terms of autonomy (should the work be individual or groups). For example, one research group has a schedule where they conduct research on their own topic of interest for one day of the week, while others may work as a given group

project. Also, issue of finance management is another organizational factor worth considering.

The organization and design of the laboratory are essential elements of any functional science laboratory activities. Seweje (2000), Olubor and Unyimadu (2001) attested that laboratory organization activity begins by providing the necessary services and equipment or materials needed in the laboratory. In designing a biology laboratory, certain considerations have to be made.

Space is one of the most important considerations in designing a biology laboratory. The biology laboratory should have a large space for free movement during learning activities. The specification of the shape (square, rectangular, circle) and dimension should be such that it provides more than adequate for the proposed or estimated number of users at a given time. Biology laboratory should have adequate ventilation that allows free flow of air in and out of the laboratory. The ventilation of a biology laboratory should be such that air is constantly replaced to prevent an increase and concentration in the air of toxic substances during practical work period.

Every biology laboratory resources should bear signs and labels of each item clearly visible and pasted. These labels and warming signs should alert students, teachers and laboratory workers to potential danger inherent in such materials. Safety facilities, chemical use and storage, emergency equipment, emergency response personnel and exit should all have signs and labels for easy identification and safety, most especially to guide first time users of the laboratory. For instance, where there are gallons of flammable liquid, they should bear a flammable liquid sticker pasted on it. That is, labels should be identified, showing, contents of containers and associated hazards; in case of emergency, names and numbers of personnel to contact example fire fighters;

location of signs for safety shower, eye wash stations, first aid equipment, exits, and areas where food and beverage consumption and storage are permitted and warming at areas or equipment where special or unusual hazard exists.

Again, there should be storage area, sometimes referred to as storeroom. In this storage room, chemicals should be stored according to compatibility and designated by hazard classes for example, flammable, irritants, corrosives, low hazards, oxidizers and poisons. The areas where chemicals are stored should be well identified such chemicals should be properly labeled and stored appropriately in the area designated for it which would be with good ventilation. The chemicals or substances that are highly toxic or other chemicals whose containers have been opened should be in unbreakable secondary containers. In addition, those chemicals or substances stored in the store room should be examined periodically (at least twice in a year) for replacement in case of deterioration and container integrity. The storeroom should be opened during normal working hours and manned by one person. It should not be used as a repackaging, demonstration or preparation room for experimental activities.

In addition to the storeroom, another ancillary room where materials, apparatus and chemical substances are prepared and assembled before they are used. This is the preparation or prep rooms. It has been observed that in some schools, a single room functions as the store and the preparatory room. These rooms are supposed to be separate. Iloeje (2008) is of the view that the following components should be included in the preparation room, benches/stools, rack of shelves, cupboard and working platforms. In addition, the following services should be provided functional water supply, electricity supply and gas sources (for heating). It is usually advisable that the preparation room and the storeroom should be next to each other.

Olubor and Unyimadu (2001) pointed out that in any biology laboratory, the provision of the following services-water drainage, gas and electricity or source of light are essential. Water service points should be installed at demonstration benches and on each side of the laboratory along the periphery of the room. For biology laboratory located in areas where water is scarce, it is advisable to install a storage tank at the roof level outside the laboratory. As an interim measure, water can be provided in large plastic containers. Electricity is another necessary requirement in a biology laboratory to enable activities to be carried out effectively. Where this is not feasible, a generator can be used. Fluorescent tubes installed at strategic points or areas such as demonstration points or benches, in-between areas and at the back of the laboratory should serve the lighting purpose of a laboratory. Where it is possible to have electricity, the natural lighting available in the laboratory should be maximized. Gas supply to biology laboratory is also essential. This should be piped from a central cylinder installed outside the laboratory building. The pipes should be laid where they can easily be repaired. The handling of gas should be laid where they can easily be strictly monitored. Where it is not possible to have gas, lamps that use spirit may be used. Good drainage is essential in biology laboratory. To reduce drainage problems in biology laboratory, the drains should be designed in such a way that they are much wider than the diameter of the holes in the sink that serve them. They should also be built in such a way that all liquid are collected in a central place and removed. Close drainages that are easy to clean are recommended.

When all the above statements and guidelines are followed, the extent of biology laboratories organization and design will be very high as there will be effective and efficient teaching and learning of science in the laboratory and the whole school by extension, Olubor and Unyimadu concluded.

2.1.11 Biology Laboratory Resources

Generally, resources refer to things available and used to meet one's need. Hornby (2006) viewed resources as things that a country, organization or individual has and can use especially to create wealth. Nweke (2000) referred to resources as human, financial and materials available in institution or organization which is used as inputs in production. It is the human and material resources used for production. When these resources are connected to the teaching and learning of practical skills in the laboratory for intellectual development, it is termed laboratory resources. Biology laboratory resources therefore refers to supplies of teachers, learners, laboratory assistants/technologists, instructional materials and other necessary devices provided to the school to increase wealth of knowledge which give help, support or comfort when the need is appropriately implemented. Biology laboratory resources had been classified into; human and material resource (Okoli & Osuafor, 2010) in Anyadiewu (2018)

The human biology laboratory resources include human beings or resourceful individuals who in one way or the other help in the effective utilization of material biology laboratory resources. These human resources include teachers, learners, laboratory assistants/technologists, resource persons and other non professional personnel (Okoli & Osuafor, 2010). Biology laboratory material resources on the other hand bears other educational names such as instructional materials, teaching materials, educational media, teaching aids, instructional facilities and instructional media. Himezie, Ike and Iwu (2002) conceived instructional facilities as devices which present a complete body of information and largely self supporting rather than supplement in teaching and learning processes. Educational material resources are those things which are manipulated, seen, heard, read or talked about plus instruments which facilitate such activities. Biology laboratory material resources includes microscope, simple hand lens,

dissecting kits, dissecting trays, brush, spatula, dropper, loop, slides, cover slips, Petridis, incubators, autoclaves, beakers, funnel, puppets, Bunsen burner, filter papers, various animal skeletons. It also includes textbooks, marker/chalkboards, models/mock ups, projectors, graphics, and others.

Practical activities using sufficient facilities enable learners to acquire cognitive skills such as formulation of hypothesis, making assumptions, designing investigations, understanding variables, observing, recording data, etc. which are necessary for engaging in faithful science investigation (Uyoata, 2006). Despite the innumerable importance of laboratory resources for teaching biology practical, many secondary schools are not measuring up to standard in the provision of these resources (Dehar, 2014). This therefore calls for assessment.

2.1.12 Basic Equipment Used in Biology Experiments

The daily routine of biologists involves the use of basic equipments such as microscopes, test tubes, beakers, Bunsen burners as well as high-tech scientific equipment and computers. These equipments are necessary for the basic studies of biology: visualizing cells and organelles as well as preparing samples of cell or fluids for testing or visualization, dissecting specimens or mixing chemicals. Magnifying equipments includes microscopes and simple hand lens; dyes and other indicators; dissecting equipments includes forceps, probes, fine scissors, scalpels, fine needles; glassware includes beakers, flasks, pipette, test tubes, cover slips, petridishes, slides and dropper; bunsen burners or stove; wire loop and Spatula (Akano, 2006).

2.1.13 Biology Laboratory Resource Management

For effective management and safety, laboratory managers need to manage and track resources like chemicals, materials, equipment and personnel that are required in the

laboratory context and they need to manage all related processes. In the opinion of Tan (2008), laboratory management entails adequate and proper care of the provided facilities, services and equipment. The manager of the biology laboratory is the biology teacher who must be prepared to commit his/ her professional, creative, technical and ingenious skills readily and intelligently to manage the laboratory effectively. Biology laboratory management also involves the management and display of materials, equipment and chemicals and the organization of these in the laboratory. Procedures and practices are carried out to make the laboratory effective and to minimize the potentials of danger to students, teachers and researchers who use chemical substances that could be hazardous. Hofstein & Mamlok-Naaman (2007) opined that biology laboratory managers should aim at creating and developing a stimulating and interesting environment in which students, science staff and ancillary staff can work with initiative towards fulfilling the goals of science teaching. It is the success in doing this that determines the strength of a science department. To effectively do all these, the laboratory managers will have an office and access to secretarial assistance to enable them carryout these duties efficiently.

Ottander and Grelsson (2006) asserted that laboratory manuals and laboratory caution signs or symbols alone will not ensure safety unless the laboratory users themselves realize the importance of personal approach to the matter. Accidents do not just happen, they are caused. The objective of safety precautions is to prevent the cause of accidents, not merely to ensure the provision of first and outfits, fire extinguishers and the like, for use after an accident has happened. It is the moral duty of everyone in science laboratories to have knowledge of materials one uses and to take due precautions. The belief that accidents could happen in science laboratories informs us of the necessity for proper management. Armed with knowledge and confidence, coupled with a due sense

of moral responsibility, the laboratory workers will take the necessary precautions to ensure safety of themselves, their colleagues and equipment.

Therefore, management of laboratory and its resources is done by cleaning on a daily, weekly, monthly or termly and yearly basis. For instance, Okeke (2002) emphasized that on daily bases windows and doors should be opened and closed at the end of the day, gas and water main taps properly shut off daily, all light and electrical appliances properly switched off, all sinks, and waste drains cleared everyday and disinfected, all apparatus not in use put away, broken glasses disposed in special bins and floors cleaned, mopped or dusted daily. For weekly management, at the beginning of each week, the store room should be checked to see whether materials are adequate and apparatus in good order for experiments and laboratory activities. The labels on the bottles should be checked to determine their effectiveness and replaced if parts are worn out. Main services such as water pipes, gas and electricity, should be repaired. The yearly management must ensure a careful audition of all laboratory equipment and materials to enable the biology teacher budget for the coming year (Okeke, 2002).

Again, refurbishment is a great option for equipment that is not running as smoothly as it once did. This involves taking the entire piece of equipment apart and fully cleaning each component. All pieces of the equipment are then polished and any movable parts are then relubricated. Parts that are faulty or showing signs of wear can also be identified and replaced during this process. Once this has been completed, the equipment is put back together and often works as well as a new item would (Ukaegbu, 2012). It was further stated by Ukaegbu that Sometimes in spite of proper maintenance and repair, equipment will reach the end of its workable life and need to be replaced. When this happens, it can be tempting to economize on equipment by choosing a less expensive model. However, it might be found that this offers a false economy,

especially if it is an important part of the laboratory that is regularly used. Choosing high quality equipment ensures it has the durability to stand up to regular use in the laboratory. Often, higher quality equipment is also easier to find parts for, and can be cleaned and refurbished more easily.

2.1.14 Common Rules and Regulations (Dos and Don'ts) of biology laboratory

Andarge & Negussie (2015) suggested that while working in the laboratory one need to always follow instructions; wear safety goggles, boots, hand gloves, nose mask and lab coats, handle chemicals carefully; no eating or drinking in the laboratory; do not smell or inhale gases directly; report accidents and breakages promptly to the laboratory attendants; do not use any equipment unless you are trained and approved as a user by your supervisor; shorts and sandals are not allowed in the laboratory; long hairs or loose clothes should be tied back or confined; work areas should be kept clear of all materials except those needed for immediate work; coats should be hung in the hall or workplace in a locker; extra books, purses, etc. should be kept away from equipment that requires airflow or ventilation to prevent overheating; any workers including students are responsible for proper disposer of used materials, if any, in appropriate containers; if a piece of equipment fails while being used, report it immediately to the lab assistant or tutor. Never try to fix the problem by yourself because you could harm yourself and others; in case of unattended lab, all ignition sources turned off, doors must be locked; never pipette anything with mouth; work area must be cleansed after completion of work and hands must be washed before leaving the lab and before eating. It is the responsibility of the laboratory manager to device and orient laboratory users about safety rules.

2.1.15 Assessment of Biology Laboratory Resources

Assessment is the systematic process of documenting and using empirical data on the knowledge, skill, attitudes and beliefs to refine and improve its purpose. It is the development and utilization of range of techniques for systematically appraising an individual or group of individuals (Okpanachi, Ejigbo & Omede, 2010). They further stated the techniques for assessment to include the use of tests, interviews, observations, etc. Linking this to biology laboratory resources, it is the development and utilization of techniques for systematically appraising the value, worth and importance of resources in the biology laboratory. Assessment of biology laboratory resources can be done daily, weekly, monthly, quarterly, annually or even more depending on the power and plan of the institution. Assessment of biology laboratory resources is important since it reveals the weakness and or strength of the laboratory. It brings to the notice of the management on the need to supply resources that are inadequate and those wearing out to be replaced.

2.2.0 Theoretical Framework

2.2.1 Piaget's Cognitive Constructivist Learning Theory.

Piaget's cognitive constructivist theory as reported by Sanni & Sanni (2010) was propounded in (1973) and proposed that children progress through a sequence of four stages, assumed to reflect qualitative differences in children's cognitive abilities. Limited by the logical structures in the different developmental stages, learners cannot be taught key cognitive tasks if they have not reached the particular stage of development. Piaget emphasized on the holistic approach to learning. To him a child constructs understanding through exploring and experiencing his or her environment. Later in (1985) Piaget expanded this theory to explain how new information is shaped

to fit with the learner's existing knowledge, and existing knowledge is itself modified to accommodate the new information. The major concepts in this cognitive process include assimilation which occurs when a learner perceives new objects or events in terms of existing schemes or operations. This information is compared with existing cognitive structures; accommodation which occurs when existing schemes or operations have been modified to account for a new experience; and equilibration which is the master developmental process, encompassing both assimilation and accommodation. Anomalies of experience create a state of disequilibrium which can be only resolved when a more adaptive, more sophisticated mode of thought is adopted. Piagetian constructivist theory generally regards the purpose of education as educating the individual child in a fashion that supports the child's interests and needs; consequently, the child is the subject of study, and individual cognitive development is the emphasis. This is a child-centered approach that seeks to identify, through scientific study, and the natural part of cognitive development. It also assumes that learners come to classrooms with ideas, beliefs, and opinions that need to be altered or modified by a teacher who facilitates this alteration by devising tasks and questions that create dilemmas for the learners. Considering the educational reflections of this theory, Piaget sees the child as continually interacting with the world around the child, solving problems that are presented by the environment and learning occurs through taking action to solve these problems. The laboratory work in this study will also be based on these principles. Within Piaget's theory, the basis of learning is discovery: to understand is to discover, or reconstruct by rediscovery and such conditions must be complied with if in the future individuals are to be developed who are capable of production and creativity and not simply repetitive. According to Piaget, children go through stages in which they accept ideas they may later discard as wrong. Understanding, therefore, is built up step by step

through active participation and involvement. Piaget further states that children begin to think logically between the age of 8 and 11 years, a stage he called the concrete operational stage of development. The average age for senior secondary schools year one (SSI) students (the targeted population for the study) is 11 years and above which implies that learners at this age can apply logical thought to practical works and be able to understand them better.

Laboratory activities require meaningful learning, i.e. learning that involves critical and creative thinking. Piaget's ideology supports this with the idea of logical thinking. This implies that teachers should create situations that would help the learners to discover facts by themselves. In this case, the teacher should establish an explorative environment for the learners to explore facts or truth by themselves. Prepackaged information can lead only to rote memorization of facts. Rote memorization is of no substantial benefit to the learner because it is not of much benefit in the exploration of the environment and the solution of problem. Individual acquires information through his interaction with the materials and the environment. Such information is retained and utilized for the solution of the environmental problem. Piaget's cognitive constructivist learning theory is related to the present study assessment of laboratory resources for conducting biology practicals in secondary schools; because laboratory work encourages students' active participation, critical thinking, problem solving abilities and others. Hence these proposition/assumptions will be embedded in the instructional strategy.

2.2.2 Vygotsky's Social Constructivist Learning Theory

Vygotsky is one amongst those who believe that children actively construct their knowledge. Vygotsky (1962) viewed cognitive development as a result of a dialectical process, where the child learns through shared problem solving experiences with

someone else, such as teachers, parents, siblings and peers. As a social constructivist theorist, Vygotsky emphasizes the social contexts of learning and the fact that knowledge is mutually built and constructed. It also emphasizes the benefits of collaboration in learning and with a more skilled tutor; an individual will facilitate transition from learners' zone of proximal development to new levels of skills and competences. Zone of proximal development (ZPD) is Vygotsky's term for the range of tasks that are too difficult for children to master alone, but can be learnt with the guidance and assistance from adults or more skilled children working independently. This implies that the science teacher should act as a facilitator by gradually withdrawing explanation, hints and demonstrations until the student is able to perform the skill alone. This will encourage the students to learn from previous knowledge they had before coming to school or the knowledge they already have to build the new knowledge.

Vygotsky (1962) also emphasized that in the practical class the science teacher is expected to sensitize learners to their environment, develop critical thinking, encourage creative thinking and encourage exploration that will enhance self directed and cooperative learning amongst the learners. Vygotsky's theory also encourages social learning and recognizes that learning involving group activities in the laboratory could improve students' academic achievement. Vygotsky theory is related to the present study which is assessment of laboratory resources for conducting biology practicals in secondary schools because it supports the view that in the laboratory, students interact with the resources or with one another in the course of practical learning .This theory plays an important function in education to guide students in learning the skills that are necessary in the culture in which they live. The teacher according to Vygotsky's view should also establish many opportunities for students to learn with the teacher and more skillful peers. In this respect it is evident from this theory that science should be taught

in such a way that students will be able to apply the knowledge outside the classroom. Practical activities in the laboratory can help achieve this. Looking at the constructivist theory as postulated by Vygotsky in the context of this study we find that achievement in biology largely depends on the learner and the environment itself and then the interactions that exist between the learners. The implication of this is that the science teacher must give the learners the opportunities to construct, produce and use experience that is meaningful to their understanding of their environment. When this is done, then they can comfortably think, reason, perceive, talk and reflect about their environment. The expectation within this study may require that learners are given the opportunities to interact with their peers, classmates and teachers in order to socially construct meaningful knowledge about their environment. Such knowledge construction will equally enhance the practical skills and subsequently better achievement in biology. The child's interaction with other people is important in the development of the child's view of the world. Through exchange of ideas with other people the learner becomes aware that self-criticism is possible only in the social interaction. Vygotsky's theory is related to the present study which is the assessment of laboratory resources for conducting biology practicals in secondary schools, because in the laboratory, students interact with the materials or with one another in the course of practical activities. Hence the result of this study will help to validate the theories.

2.3 Empirical Studies

2.3.1 Empirical study on science laboratory in secondary schools

Adeyemi (2008) examined Science laboratory and quality of output in secondary schools in Ondo State, Nigeria. The researcher adopted descriptive survey study design. The study population comprised of all the two hundred and fifty seven (257) secondary schools n the state. The sample consisted of one hundred and sixty eight (168) schools

drawn randomly from the study population. Inventory was used as the instrument for data collection. The data collected was analyzed using the one-way analysis of variance and Least Significant Degree test. Semi structured interview were conducted for principals and education officers while their responses were analyzed through the content analysis technique. The findings showed that the quality of output was best in the schools having laboratories in the three (3) science subjects; physics, chemistry and biology. The mean scores were highest in the three science laboratories. It was recommended on the basis of findings that government should urgently laboratories in the three science subjects in schools with shortage science laboratories.

2.3.2 Empirical studies on assessment of laboratory

Getachew and Harrison (2016) carried out a study in Ethiopia on Assessing Laboratory Skills Performance in Undergraduate Biology Students. The purpose of the study was to evaluate the laboratory skills performance of undergraduate biology students in Ethiopian universities based on skill performance rubric. Individual laboratory practical skill performance test was implemented with 55 randomly selected third year biology students from three universities in a laboratory setting under supervision of the raters. Five level scale questionnaires were administered to 208 third year biology students, 26 biology instructors and 2 laboratory assistants. The results showed that the laboratory skill performance test score was below the midpoint with significantly different between the old and the middle as well as the new university. Correlation and multiple regression analyses showed that teachers' experience had significant positive regression weight. From the results of the analysis, it is recommended that in biology laboratory, performance-based assessment needs to be undertaken in placement to written exam and instructors need much more assistance and professional development of biology

laboratory performance skills as well as pedagogies of how to assess the laboratory performance skills of their students.

2.3.3 Empirical study on availability, utilization and maintenance of biology laboratory resources

Ukaegbu (2012). The study investigated the provision and management of Biology Laboratory Resources (BLR) in Colleges of Education (COE) in South Eastern Nigeria (SEN). Five research questions guided the study. It sought to find out biology laboratory resources available in COE, the extent of adequacy in the provision of BLR in COE and the extent of utilization of BLR by teachers and students. It also tried to find out factors militating against effective provision, utilization and management of BLR as well as strategies for enhancing the provision and management of BLR in COE. Descriptive survey research design was employed for the study and a sample of 359 final years NCE biology students, 41 lecturers and 6 laboratory assistants/technologists totaling 406 respondents were used for the study. The instrument used for data collection was a researcher developed questionnaire tagged Questionnaire on Provision and Management of Biology Resources (QPMBR). The questionnaire has 200 items. Descriptive statistics including percentages, mean and standard deviation were used to answer research questions while ranking was used to ascertain the relative position of the items in their order of priority/effect. It was revealed from the study that, 88% of BLR are available in biology laboratories such as interactive white boards, prepared slides, chemicals, textbooks, beakers, flasks of different types, microscopes, first aid box, hand lens, maps, models, computers, dissecting kits, fire extinguishers, thermometers, insect nets, bell jars, incubator, water baths, freezers and lecturers as well as students. The study also revealed that biology laboratory resources are not adequately provided for in COE. Additionally, due to inadequacy in the quantity and quality of BLR provided to COE,

students and lecturers find it difficult to utilize BLR effectively. Different factors ranging from inadequate fund; over enrollment of students into COE; inadequacy in quantity and quality of human and material resources; lack of storage facilities; lack of supervision; lack of proper documentation and logistics together with ignorance on the proper usage of resources due to lack of training were found to militate against provision, utilization and management of BLR in COE. Based on the above problems, it was recommended that biology departments should be adequately funded; staff, students and laboratory technologists/assistants should be adequately trained on proper management and improvisation of BLR; appropriate storage of material resources; provision of accurate records/logistics; replacement/repair of damaged/faulty laboratory materials; appropriate planning, implementation, supervision, monitoring and evaluation of all biology laboratory utilizers among others were suggested as strategies for improving provision and management of BLR in COE.

Muhammad (2017) embarked on a study titled A Survey of Availability, Utilization and Maintenance of Biology Laboratory Equipment and Facilities in Secondary Schools in Sokoto State, Nigeria. The study examined the availability, use, and extent of maintenance of laboratory facilities in secondary schools in Sokoto State. Descriptive survey design was adopted for the study. A sample of 30 Senior Secondary Schools and 30 biology teachers was selected from the population of secondary schools in the state using stratified sampling technique. Four research questions were answered using observation schedule. Findings of the study indicated that most senior secondary schools in Sokoto State have no laboratories. Where they exist, they are poorly equipped. Teachers indicated reluctance and inability in conducting practical works using the few available laboratory facilities. Poor maintenance culture was also discovered among biology teachers in Sokoto state. It was recommended among others

that science laboratories should be well equipped with relevant and modern facilities for effective teaching. Teachers should try to improvise using local materials; they should also develop maintenance culture to ensure longer life span of the few available facilities.

2.3.4 Empirical study on effect of practical laboratory teaching in secondary schools

Anyadiegwu (2018) The survey of availability and utilization of laboratory resources in teaching and learning biology in Enugu North LGA, Enugu State, It adopted a descriptive survey research design and was guided by one (1) checklist and two (2) research questions. It sought to find out laboratory resources available for teaching and learning biology in secondary schools in Enugu North LGA, the extent of adequacy in the provision of laboratory resources in secondary schools and the extent of utilization of the laboratory resources by the biology teachers in teaching and learning biology. Descriptive survey research design was employed for the study, a population of thirty six (36) teachers, due to factors that could not be controlled by the researcher a total of (20) respondents were used for the study, the total number of teachers of secondary schools in Enugu North LGA is thirty six(36) for this reason, there was no need for sampling . The instrument used for data collection was a researcher developed questionnaire tagged Questionnaire on Availability and Utilization of Laboratory Resources in teaching and learning Biology (QAULR). The questionnaire has sixty (60) items. Descriptive statistics including percentages, mean and standard deviation were used to answer research questions while frequency was used to ascertain the relative position of the items in their order of priority/effect. It was revealed from the study that a total of sixteen out of the twenty listed items were available of in biology laboratories. The study also revealed that laboratory resources are not adequately provided for in

secondary schools. Additionally, due to inadequacy in the quantity and quality of laboratory resources provided to secondary schools, students and teachers find it difficult to utilize the laboratory effectively. Different factors ranging from inadequate fund; over enrollment of students into government secondary schools; inadequacy in quantity and quality of human and material resources; lack of storage facilities; lack of supervision; together with ignorance on the proper usage of resources due to lack of training were found to militate against provision, utilization of laboratory resources in secondary schools. Based on the above problems, it was recommended that biology laboratories should be adequately funded; staff, students and laboratory technologists/assistants should be adequately trained on proper improvisation of laboratory; appropriate storage of material resources; provision of accurate records/logistics; replacement/repair of damaged/faulty laboratory materials; appropriate planning, implementation, supervision, monitoring and evaluation of all biology laboratory utilizers among others were suggested as strategies for improving provision and utilization of laboratory resources in secondary schools.

Abraham (2018) examined the Effect of Practical Laboratory Teaching Strategy on Senior Secondary School Students Achievement on Osmosis in Plant Cells in Chanchaga Local Government Area, Minna, Niger state. The research adopted quasi experimental pre-test, post-test research design. The population consists of all the Senior Secondary Schools in Chanchaga Local Government area, Minna. 80 students from four schools were randomly selected. Three research questions guided the study and three research hypotheses were raised for the study. The instrument used in gathering data compromised a structured pre-test and post-test OAT (Osmosis Achievement Tests). Data were analyzed using mean standard deviation and T-test. The study revealed that factors like method of teaching, gender and school type contribute to

the rate of student's achievement. Based on these findings, it was recommended that appropriate teaching method should be used and seminars should be organized to all the schools in Minna on how to use practical and lecture teaching strategy.

Again, Chibabi, Umoru, Onah and Itodo (2018) examined the Effect of Laboratory Method on Students' Achievement And Retention In Senior Secondary Schools Biology In Kogi East Senatorial Zone The study was conducted to determine the effect of laboratory method of teaching on senior secondary school students' achievement and retention in Biology in Kogi East Senatorial Zone. The effect of gender was also examined the study has four research objectives, answered four research questions and tested four null hypotheses. A quasi experimental design of non equivalent group was adopted. Students Biology Achievement Test (SBAT) was developed and administered to 365 samples drawn from 14,920 populations of Senior Secondary School II students using Yaro Yamen. The instrument (SBAT) was validated by three experts and its reliability coefficient was established as 0.87 using test retest method. The experimental group was taught using laboratory method of teaching while the control group was taught using traditional method of teaching as the study lasted for three weeks. Data for the research questions were analyzed using descriptive statistics of means and standard deviation, while the null hypotheses formulated were tested at 0.05 level of significant using ANCOVA. Results of the study revealed significant difference of the achievement, retention and interaction effect between teaching method and the gender of student in the mean gain achievement scores of students taught using laboratory method of teaching and their counterparts taught using traditional method of teaching. The study revealed significant difference in the academic achievement and retention of male and female school students exposed to laboratory method of teaching. The study concluded that laboratory method of teaching is an effective approach of teaching

biology at the senior secondary school level. The study recommended that school authority should ensure that teachers should use laboratory method of teaching some basic concepts in biology as it is the most effective teaching method.

2.3.5 Empirical study on the assessment of laboratory resources in secondary schools

Oladeji, Adebisi & Tewogbade (2017) carried out a study assessment of the availability of laboratory resources, teachers' and students' involvement in practical activities in Basic Science in junior secondary schools in Osun State Nigeria. These were with a view to ascertain the availability of laboratory resources in the teaching of Basic Science in junior secondary schools and the involvement of teachers and students to practical activities in the state. The study employed a descriptive survey research design. The population for the study consisted of all Basic Science teachers, facilities for teaching Basic Science and all junior secondary school II students in Osun State. Ten schools were selected from each senatorial district through simple random sampling technique, from each school, ten students from JSSII were also randomly selected through simple random sampling technique to take part in the study. Basic Science teachers found in the schools were purposively used for the study because of their discipline and numbers. The facilities for the research were also purposively selected based on a must for teacher to use in the course of their teaching. Three instruments were used for data collection. They are: Observation Checklist for Basic Science Laboratory Facilities (OCBSLF), Questionnaire for Teachers on Teachers Involvement in Practical Activities (QTTIPA) and Students' Questionnaire on Basic Science Laboratory Facilities (SQBSLF). Data collected were analyzed through simple percentages. The results of the study showed that 14(40.0%) schools indicated that beakers, boiling tubes, conical flask and cylinder are available while 21(60.0%) schools

indicated that beakers, boiling tubes, conical flask and cylinder are not available, 10(28.6%) schools indicated that flat bottom flasks are available while 25(71.4%) schools indicated they are not available, 11(31.4%) schools indicated that round bottom flasks are available while 24(68.6%) schools indicated they are not available, 8(22.9%) schools indicated that hand lenses are available while 27(77.1%) schools indicated they are not available, 7(20.0%) schools indicated that Ammeters are available while 28(80.0%) schools indicated they are not available, 9(25.7%) schools indicated that Resistance box are available while 26(74.3%) schools indicated they are not available, 3((8.57%) schools indicated that plastic mammalian models (heart ,eye, ear, and skeleton) and First Aid box (fully equipped) 3((8.57%) are available while 32(91.3%) schools indicated that they not available, 1(2.86%) schools indicated that Meter Rule, Rheostats, Connecting wires, Spatula are available while 34(97.4%) schools indicated they are not available. The results of the study showed that on the average teachers did not use laboratory facilities to teach the students and students are rarely involved in practical activities in schools. The study concluded that laboratory resources are not available to teach students Basic Science in junior secondary school level.

2.4 Summary of the Review of Related Literatures

The review of literatures was done on many concepts, theories and empirical studies.

The concept of biology refers to the study of living things and their relationship with the environment. The characteristics of living things include order, sensitivity, adaptation, reproduction, growth and development, regulation, homeostasis and energy processing. Biology education is a deliberate transfer of skills, dispositions, knowledge, habits, attitudes, values and norms to prospective teachers. It is of importance to both the individual and the society. The types of laboratories includes analytical quality laboratories, clean rooms, clinical and medical laboratories, incubator laboratories,

production laboratories and research and development laboratories in which category this type is based.

The review revealed that the history of laboratory started as far back as 16th centuries. Laboratory techniques are set of procedures used on the natural science to conduct experiments. Laboratory equipment are the various tools and other material resources used by scientists working in the laboratory. It was revealed that safety is necessary to be maintained in the laboratories so as to prevent laboratory accidents.

Organization and design of laboratory is dependent on the purpose and services for which to achieve. In planning laboratories, factors like space, ventilations, signs and labels, store rooms and preparatory rooms are to be considered.

Biology laboratory resources are supplies of teachers, laboratory assistants/technicians, instructional materials and other necessary devices provided to the school to increase wealth of knowledge. This is grouped into human biology laboratory resources and materials biology laboratory resources. Basic equipment used in biology experiment are grouped magnifying equipment; microscope and simple hand lens, slides, test-tubes, Petri-dish, fine hairbrush/wire loop and spatula; dyes and indicators, dissecting equipment; forceps, probes, fine scissors, scalpels, fine needles, glassware such as beakers, flasks, pipette and Bunsen burner.

Laboratory resource management is the various ways of maintaining the laboratory resources so as to serve better. The laboratory resource management includes cleaning of equipment periodically, replacement of parts or equipment worn out and refurbishment. The review also revealed that laboratory rules and regulations are to be adhered to while working in the laboratory. Assessment of biology laboratory resources is the development and utilization of techniques for systematically appraising the value,

worth and importance of resources in the biology laboratory. This can be done daily, weekly, monthly, quarterly or annually to checkmate the strength and weakness of the laboratory.

Theory of learning, cognitive theories of learning and the learning style theory. It was revealed that learning depend on the individual preferred method for approaching learning and gaining knowledge preferred learning style which include watching, thinking, touching and doing thus, enhance learning faster and satisfactory improvement.

Empirical studies reviewed revealed that laboratory activities are of great importance to the learning, assimilation and retention of concepts in biology. This is aided by laboratory resources. Many works has been done in relation to biology laboratories but no special attention given to the assessment of biology laboratory resources in secondary schools in Minna metropolis. It is on this note that this work tends to fill the gap.

CHAPTER THRE

3.0 RESEARCH METHODOLOGY

This chapter is concerned with an overview of the research methodology. It is organized under the following sub-headings: research design, area of the study, population of the study, sample and sampling technique, instrument for data collection, validation of the instrument, trial testing, and reliability of the instrument, method of data collection and procedures for data analyses.

3.1 Research Design

The study adopted the descriptive survey research design. Ali (2006) described descriptive survey design as the documentation and description of what exists or the present status of existence or absence of what is being investigated without any manipulation of what caused the event. It develops a profile on what is and not why it is so. The design is considered appropriate for the study because it is based on the views, opinions of respondents as well as resources available in the area of study.

3.2 Population of the Study

The population of this study comprised of 81 biology teachers in the 23 public secondary schools in Minna metropolis, Niger state (2019/2020 Academic Session).

3.3 Sample and Sampling Technique

The sample of this study shall comprise sixty-nine (69) respondents selected from public secondary schools in Minna metropolis, Niger State. This was done using Morgan Table which stipulated that when you have population, use sample of 66. Three respondents were selected to represent each public secondary schools thus; 3x23=69.

3.4 Instrument for Data Collection

A structured questionnaire was used for data collection, titled Questionnaire on Assessment of Laboratory Resources for Conducting Biology Practicals in Secondary Schools (QALRCBPSS) and is divided into six (6) sections (A-F). (See appendix I). Section A was designed to obtain demography of respondents and sections B-F were to elicit information from the respondents to answer the five (5) research questions. The entire questionnaire contained one hundred and thirty-four (134) items. Section B was tagged Availability of Biology Laboratory Facility for Conducting Biology Practicals in Public Secondary Schools (ABLFCBPPSS) containing four (4) items which was structured with four (4) options of Strongly Agree, Agree, Disagree and Strongly Disagree. It sought information on the availability of the laboratory for conducting biology practicals in public secondary schools. Section C was tagged Biology Laboratory Resources Availability Assessment Inventory (BLRAAI) containing thirty-six (36) items which sought information on the availability of biology laboratory resources in public secondary schools. It was structured with two (2) options of Yes/No (Available/Not-Available). Sections D-F was modified Likert type of scale. Section D was tagged Adequacy of Biology Laboratory Resources Provision Inventory (ABLRPI) which sought information on the extent of provision of biology laboratory resources in public secondary schools in Minna metropolis. It contained thirty-six (36) items which was structured four (4) options of (VGE) Very Great Extent, (GE) Great Extent, (ME) Moderate Extent and (LE) Low Extent. Section E was tagged Functionality of Biology Laboratory Resources (FBLR) which sought information on the extent to which biology laboratory resources are functional in the public secondary schools in Minna Metropolis. It contained thirty-six (36) items which was structured four options of (VGE) Very Great Extent, (GE) Great Extent, (ME) Moderate Extent and (LE) Low

Extent. Section F was tagged Biology Laboratory Resources Maintenance Assessment Scale (BLRMAS) which sought information on how effective the biology laboratory resources are maintained in the public secondary schools in Minna metropolis. It contained twenty-two (22) items which; 1-10 deals on material biology laboratory resources maintenance while, 11-22 deals on human biology laboratory resources maintenance. It is structured four (4) options of (SA) Strongly Agree, (A) Agree, (D) Disagree and (SD) Strongly Disagree.

3.5 Validation of the Instrument

The instrument for data collection was validated by four (4) specialists in Federal University of Technology, Minna (FUT Minna) for face, content and constructs validity. One validator was from biology department, one from educational technology, one from measurement and evaluation and one from science education. The validators were asked to check appropriateness of the instrument for the purpose it's designed for, clarity and simplicity of the language used, suitability for the level of the targeted audience, the extent in which the items cover the topic it meant to cover, the structure of the questionnaire, others (grammatical errors, spelling errors and others), general overview of the instrument and suggestions for improving the quality of the instrument. The comments, observations and criticisms made by the validators shall be promptly adjusted by the researcher.

2.6 Trial Testing of the Instrument

After the modifications of the items in line with the recommendations of the experts' criticisms and comments, the instrument was administered to a sample of five (5) biology teachers from private secondary schools in Bosso local government area. These teachers were selected outside the sample for this study.

3.7 Reliability of the Instrument

After trial testing, the instrument (QALRCBPSS) was subjected to a test of internal consistency to ensure its reliability. Research question 2 was analyzed using Kudder-Richardson formular 20 (K-R 20) to test the reliability of dichotomously scored items. Research questions 1, 3, 4 and 5 were tested using Cronbach's Alpha for multiple scored items. A reliability coefficient of 0.77 was obtained. This high reliability coefficient shows that the instrument (QALRCBPSS) is reliable.

3.8 Method of Data Collection

In collecting the data for the study, the researcher shall visit the schools with a letter of introduction from the head of the department to the principals who will then grant access to the respondents to respond to the instrument. Administration of the instrument to the respondents will be done with the help of research assistants trained by the researcher. The instruments will be collected immediately they are completed.

3.9 Method of Data Analyses

This is concerned with research techniques for making replicable and valid reference from data collected. Tables and other statistical inferences shall be made from the data collected. Responses were analyzed using percentages, representations such as pie charts, column charts, bar charts and others will used for easy and quick interpretation of data.

CHAPTER FOUR

4.0 DATA ANALYSIS AND DISCUSSION

This chapter represents the findings of the study in relation to the research questions raised in the study.

4.1 Section A: Respondents' Bio-Data

4.1.1 Bio-Data on Gender

The researcher classified the respondents according to their gender to get representation from both genders hence eliminating biasness that could be generated by getting information from one gender. The findings are represented in table 4.1

TABLE 4.1 Frequency table respondents' Bio-Data on Gender

GENDER	FREQUENCY	PERCENTAGE
Male	21	30.4
Female	48	69.6
Total	69	100

The finding of the study indicated that out of the total number of the 69 respondents, 21 of them were male forming 30.4% and 48 were female forming 69.6%. This therefore means that the representation of the respondents in this survey was unbiased.

4.2 Academic Qualification

The researcher grouped the respondents according to their level of education in order to get information from across the board; this is as represented below in table 4.2

Table 4.2 Academic Qualification of the Respondents

TEACHING QUALIFICATIONS	FREQUENCY	PERCENTAGE
OND		
HND		
NCE		
B.Sc/B.Tech	52	75.4
M.Ed	17	24.6
Ph.D		
Total	69	100

The findings indicate that among the respondents; 52 respondents had B.Sc/B.Tech which comprised of 75.4% and 17 respondents had M.Ed comprising 24.6%. This therefore revealed that the respondents had different levels of qualifications and therefore a good group to provide the information that the study required. Therefore, the researcher was in a position to obtain the relevant information pertaining the study.

4.3 Years of Experience

The study sought to establish the number of years that the respondents had spent working hence, this contribute to the quality of information needed for the study. The finding are represented in table 4.3

Table 4.3 Years of Experience of respondents

TEACHING EXPERIENCE	FREQUENCY	PERCENTAGE
0-2YEARS	14	20.3%
3-5YEARS		
6-10YEARS		
11YEARS ABOVE	55	79.7%
TOTAL	69	100

Results from the study indicated that 69 respondents, 14 respondents constituted 20.3% have less than 2years working expireince while 55 respondents comprised of 79.7% have 11 years and above as working experiences. As source of information, they form a good basis since one can get all the information needed for the study.

4.4 SECTION B: Availability of Biology Laboratory Facility for Conducting Biology Practicals in Public Secondary Schools (ABLFCBPPSS)

What laboratory resources are available for conducting biology practicals in biology laboratories of public secondary schools in Minna metropolis?

Table 4.4 Frequency Table on Availability of Biology Laboratory Facility

S/N	QUESTIONS	SA		A		D		SD		DECISION
		Freq	%	Freq	%	Freq	%	Freq	%	
1	There is a biology laboratory in my school.	35	50.7	34	49.3					Accepted
2	The biology laboratory is also used to conduct physics, chemistry and agric. Practicals.			23	33.3	19	27.5	27	39.1	Not Accepted
3	The biology laboratory is large enough to accommodate students while carrying out practicals.			45	652.	24	34.3			Accepted
4	The biology laboratory is always open for students to carry out pracicals.			69	100					Accepted

Table 4.4 above shows the frequencies and percentages of the respondents as regards to the availability of biology laboratory facility in public secondary schools in Minna metropolis. It is made up of four (4) items four items used in answering this research question one. Each item is judged available and not available using 50% as the decision rule.

The first item which is about the availability of biology laboratory facility, 35 respondents comprised of 50.7% answered strongly agreed while the remaining 34 respondents comprised 49.3% answered agreed. Judging from the result, there is biology laboratory facility in public secondary schools in Minna metropolis.

Item two which is about the use of biology laboratory resources for conducting other subjects' practicals was answered agreed by 23 respondents comprised of 33.3%, 19

respondents comprised of 27.5% answered disagreed while 27 respondents comprised of 39.1% answered strongly disagreed. Inferring from the result above, some schools are using multipurpose science laboratory while others have specific laboratory for conducting biology laboratory.

Item three (3) inquiring on the space in the biology laboratory if large enough to accommodate students while carrying out practicals received 45 respondents comprised of 65.2% who answered agreed and 24 respondents comprised of 34.2% responded disagreed. The results thus shows that the biology laboratories in public secondary schools are large enough to accommodate students while carrying out biology practicals.

Item four (4), the biology laboratory is always open for students to carry out pracicals received the whole 69 respondents comprised of 100% answered agreed. The result thus revealed that biology laboratory is always opened for the students to carry out biology practials.

4.5 SECTION C: Biology Laboratory Resources Availability Assessment Inventory (BLRAAI)

What laboratory resources are available for conducting biology practicals in biology laboratories of public secondary schools in Minna metropolis?

Table 4.5 Frequency Table on Availability of Biology Laboratory Resources

S/NO.	MATERIAL RESOURCES	AVAILABILTY		NOT AVAILABLE		DECISION
		Frequency	Percentage	Frequency	Percentage	
1	Microscopes	58	84.1%	11	15.9	Available
2	Hand lens	69	100%			Available
3	Interactive boards (white, black, etc.)	58	84.1%	11	15.9	Available
4	Incubators			69	100%	Not Available
5	Filter papers	52	75.4%	17	24.6%	Available
6	Drying oven			69	100%	Not Available
7	First aid box	69	100%			Available
8	Weighing balances	69	100%			Available
9	Projector			69	100%	Available
10	Prepared slides	55	79.7%	14	20.3%	Available
11	Real objects	69	100%			Available
12	Water baths	54	78.3%	15	21.7%	Available
13	Centrifuges	13	18.8%	56	81.2%	Available
14	Refrigerators/freezers			69	100%	Not Available
15	Pipettes/burettes	69	100%			Available
16	Measuring cylinders	69	100%			Available
17	Autoclave	9	13.0%	60	87.0%	Available
18	Chemicals	69	100%			Available
19	Reagent bottles	69	100%			Available
20	Beakers	69	100%			Available
21	Bunsen burners/ Stove	69	100%			Available
22	Conical flasks/ Vacuum flasks	69	100%			Available
23	Dissecting kits	63	91.3%	6	8.7%	Available
24	Litmus papers (white, blue, red)	69	100%			Available
25	Fire extinguisher	69	100%			Available
26	Desiccators	63	91.3%	6	8.3%	Available
27	Test tubes	69	100%			Available
28	Petri dishes	69	100%			Available
29	Retort stand	69	100%			Available
30	Wire gauze	64	92.8%	5	7.2%	Available
31	Insect nets	69	100%			Available
32	Thermometers	69	100%			Available
33	Bell jars	65	94.25	4	5.8	Available
	HUMAN RESOURCES					
34	Teachers	69	100%			Available
35	Laboratory Assistants	69	100%			Available
36	Students	69	100%			Available

Table 4.5 above shows the frequencies and percentages of the respondents as regards to the availability of biology laboratory resources in public secondary schools in Minna metropolis. It is made up of thirty-six (36) items. Each item is judged available and not available with 50% as the decision rule.

Items 1and 3 showed frequencies of 58 respondents each constituting 84.1% responded available and 11 respondents constituting 16.9% responded not available, thus the items are considered available. Items 2,7,8,11,15,16,18,19,20,21,22,24,25,26,27,28,29,31,32,34,35 and 36 shows frequencies of 69 respondents each representing 100% responded available, thus the items are considered available. Items 4,6,9 and 14 shows frequencies of 69 respondents each representing 100% responded not available, thus the items are considered not available. Items 5 shows frequency of 52 respondents representing 75.4% responded available and frequency of 17 respondent representing 24.6% responded not available, thus the item is considered available. Items 10 shows frequency of 55 respondents representing 79.7% responded available and frequency of 14 respondent representing 20.3% responded not available, thus the item is considered available. Items 12 shows frequency of 54 respondents representing 78.3% responded available and frequency of 15 respondent representing 21.7% responded not available, thus the item is considered available. Items 13 shows frequency of 13 respondents each constituting 18.8% responded available and frequencies of 56 respondents representing 81.2% responded not available, thus the item is considered not available. Items 17 shows frequency of 9 respondents representing 13.0% responded available and frequency of 60 respondent representing 87.0% responded not available, thus the item is considered not available. Items 23 and 26 shows frequencies of 63 respondents representing 91.3% responded available and frequency of 6 respondent representing 8.7% responded not available, thus the items are considered available. Items 30 shows frequency of 64

respondents representing 92.8% responded available and frequency of 5 respondent representing 7.2% responded not available, thus the item is considered available. Items 33 shows frequency of 65 respondents representing 94.2% responded available and frequency of 4 respondent representing 5.8% responded not available, thus the item is considered available.

Inferring from the above result items like incubator, drying oven, projector, refrigerator, and autoclave are not available while others are available in public secondary schools in Minna metropolis.

4.6 SECTION D: Adequacy of Biology Laboratory Resources Provision Inventory (ABLRPI)

Biology laboratory resources are adequately provided for in public se6condary schools in Minna metropolis.

Table 4.6 Frequency Table on Adequacy of Laboratory Resources

(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/N	Material Resources	SA		A		D		SD		Decision
		Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	
1	Microscopes	46	66.7	12	17.4	11	15.9			Adequate
2	Hand lens	42	60.7	27	39.1					Adequate
3	Interactive boards (white, black, etc.)	46	66.7	27	39.1					Not adequate
4	Incubators					6	83	63	91.4	Not adequate
5	Filter papers	6	91.7	6						Adequate
6	Drying oven					6	8.3	3	91.7	Not Adequate
7	First aid box	35	50.7	34	49.3					Adequate
8	Weighing balances	40	58.3	29	41.76					Adequate
9	Projector					57	82.	12	17.4	Not Adequate
10	Prepared slides	35	50.7			34	49.3			Not Adequate
11	Real objects	63	91.3	6	3.7					Adequate
12	Water baths	35	50.7			34	49.3			Adequate
13	Centrifuges			6	8.7	63	91.3			Not Adequate
14	Refrigerators/freezers					60	87.0	9	13.0	Not Adequate
15	Pipettes/burettes	57	83.3	12	16.7					Adequate
16	Measuring cylinders	63	91.7	6	8.3					Not Adequate
17	Autoclave	6	8.3			63	91.7			Not Adequate
18	Chemicals	63	91.7	6	8.3					Adequate
19	Reagent bottles	63	91.7	6	8.3					Adequate
20	Beakers	63	91.7	6	8.3					Adequate
21	Bunsen burners/ Stove	57	83.3	12	16.7					Adequate
22	Conical flasks/ Vacuum flasks	57	83.3	12	16.7					Adequate
23	Dissecting kits	63	91.7			6	33			Adequate
24	Litmus papers (white, blue, red)	63	91.3	6	3.7					Adequate
25	Fire extinguisher	63	91.3	6	3.7					Adequate
26	Desiccators	53	76.8	4	5.8	12	16.7			Adequate
27	Test tubes	57	83.3	12	16.7					Adequate
28	Petri dishes	57	83.3	12	16.7					Adequate
29	Retort stand	52	75.0	17	25.0					Adequate
30	Wire gauze	57	83.3	12	16.7					Adequate
31	Insect nets	63	91.7	6	8.3					Adequate
32	Thermometers	63	91.7	6	8.3					Adequate
33	Bell jars	63	91.7			6	8.3			Adequate

	HUMAN RESOURCES					
34	Teachers	34	49.3	35	50.7	Adequate
35	Laboratory Assistants	57	83.3	12	16.7	Adequate
36	Students	46	66.3	22	33.3	Adequate

Table 4.6 above shows the frequencies and percentages of the respondents as regards to the adequacy of biology laboratory resources in public secondary schools in Minna metropolis. It is made up of thirty-six (36) items. Each item is judge adequate and not adequate with 50% as the decision rule.

Item 1 has frequency of 46 respondents representing 66.7% responded strongly agreed, frequency of 12 respondents constituting 17.4% responded agreed and frequency of 11 respondents 15.9% responded disagree, thus the item is considered adequate. Item 2 has frequency of 42 respondents representing 60.9% responded strongly agreed and frequency of 27 respondents representing 41.7% responded agreed, thus the item is considered adequate. Item 3 has frequency of 46 respondents representing 66.7% responded strongly agreed and frequency of 23 respondents representing 25.0% responded agreed and 1 respondent constituting 8.3% responded strongly disagreed, thus the item is considered adequate. Item 4 has frequency of 6 respondent representing 8.3% responded agreed and frequency of 63 respondents with 91.7% responded disagreed, thus the item is considered not adequate. Item 5 has frequency of 63 respondents representing 91.7% responded strongly agreed and frequency of 6 respondents with 8.3% responded agreed, thus the item is considered adequate. Item 6 has frequency of 6 respondent representing 8.3% responded strongly agreed and frequency of 63 respondents with 91.7% responded disagreed, thus the item is considered not adequate. Item 7 has frequency of 35 respondents constitutes 50.7% responded strongly agreed and frequency of 34 respondents represents 49.3% responded agreed, thus the item is considered adequate. Item 8 has frequency of 40 respondents representing 58.3%

responded strongly agreed and frequency of 29 respondents representing 41.7% responded agreed, thus the item is considered adequate. Item 9 shows frequency of 58 respondents with 82.6% responded disagreed and frequency of 12 respondents representing17.4% responded strongly disagreed. Thus the item is considered not adequate. Items 10 and12 have frequencies of 35 respondents with 50.7% responded agreed each and frequency of 34 representing 49.3% responded disagreed respectively, thus the items are considered adequate. Items 11,18,19,20,24,25,31 and 32 shows frequencies of 63 respondents each representing 91.7% responded strongly agreed and frequency of 6 respondents each representing 8.3% responded agreed, thus the items are considered adequate. Item 13 have frequency of 6 respondents representing 8.3% responded agreed and frequency of 63 respondents representing 91.7% responded disagreed, thus the item is considered not adequate. Item 14 have frequency of 60 respondents constituting 87.0% responded agreed and frequency of 9 respondents representing 13.0% responded agreed, thus the item is considered adequate. Item 15 have frequency of 57 respondents constituting 83.3% responded strongly agreed and frequency of 12 respondents representing 16.7% responded agreed, thus the item is considered adequate. Item 16 has frequency of 63 respondents with 91.7% responded strongly agreed and frequency of 6 respondent representing 8.3% responded agreed, thus the item is considered adequate. Item 17 has frequency of 6 respondent representing 8.3% responded strongly agreed and frequency of 63 respondents representing 91.7% responded disagreed, thus the item is considered not adequate. Items 21,22,27,28 and 35 have frequencies of 57 respondents each representing 83.3% responded strongly agreed and frequencies of 12 respondents each constituting 16.7 responded agreed respectively, thus the items are considered adequate. Item 23 has frequency of 63 respondents constituting 91.7% responded strongly agreed and frequency of 6 respondent constituting

8.3% responded disagreed, thus the item is considered adequate. Item 26 shows frequency of 53 respondents constituting 76.8% responded strongly agreed, frequency of 4 respondents representing 5.8 and frequency of 12 respondents representing 16.7% responded disagreed, thus the item is considered adequate.

Item 29 shows frequency of 52 respondents representing 75.0% responded strongly agreed and frequency of 17 respondents representing 25.0% responded agreed, thus the item is considered adequate. Item 30 has frequency of 57 respondents representing 83.3% responded strongly agreed and frequency of 12 respondents representing 16.7% responded disagreed, thus the item is considered adequate. Item 33 shows frequency of 63 respondents representing 91.7% responded strongly agreed and frequency of 6 respondents with 8.3% responded agreed, thus the item is considered adequate. Item 34 has frequency of 34 respondents representing 49.3% responded strongly agreed and frequency of 35 respondents constituting 50.7% responded agreed, thus the item is considered adequate. Item 36 has frequency of 46 respondents with 66.7% responded strongly agreed and frequency of 22 respondents constituting 33.3% responded agreed, thus the item is considered adequate.

Inferring from the result above, items 4,6,9,13,14 and 17 are not adequately provided while the rest items are adequately provided.

4.7 SECTION E: Functionality of Biology Laboratory Resources (FBLR)

Biology laboratory resources are extensively functional in my school.

(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/N	MATERRIAL RESOURCES	SA		A		D		SD		Decision
		Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	
1	Microscopes	12	16.7	35	50.7	24	33.3			Not Functional
2	Hand lens	6	8.3	6.3	91.7					Functional
3	Interactive boards (white, black, etc.)	5	6.5	42	58.3					Functional
4	Incubators					57	83.3	12	16.7	Not Functional
5	Filter papers	12	16.7	52	75.0	6	83			Functional
6	Drying oven					64	92.8	5	72	Not Functional
7	First aid box	35	50.7	34	49.3					Fuctional
8	Weighing balances	45	66.7	12	16.7	12	16.7			Functional
9	Projector					35	50.7	34	49.3	Not Functional
10	Prepared slides	52	75.0	12	16.7	6	83			Functional
11	Real objects	34	49.3	35	50.7					Functional
12	Water baths	40	58.7	12	16.7	17	25.0			Functional
13	Centrifuges					57	38.3	12	16.7	Not Fuctinal
14	Refrigerators/freezers					63	91.7	6	8.3	Not functional
15	Pipettes/burettes	35	50.7	34	49.3					Functional
16	Measuring cylinders	34	49.3	35	50.7					Functional
17	Autoclave	12	16.7	17	25.0	23	33.3	17	25.0	Functional
18	Chemicals	29	41.7	40	58.3					Functional
19	Reagent bottles	40	58.3	29	41.7					Functional
20	Beakers	34	49.3	35	50.7					Functional
21	Bunsen burners/ Stove	46	66.7	22	33.3					Functional
22	Conical flasks/ Vacuum flasks	22	33.3	46	66.7					Functional
23	Dissecting kits	46	66.7	12	16.7	12	16.7			Functional
24	Litmus papers (white, blue, red)	35	50.7	34	49.3					Fuctional
25	Fire extinguisher	35	50.7	34	49.3					Fuctional
26	Desiccators	12	16.7	12	16.7	45	66.7			Not Functional
27	Test tubes	40	58.3	29	41.7					Functional
28	Petri dishes	34	49.3	35	50.7					Functional
29	Retort stand	29	41.7	40	58.3					Functional
30	Wire gauze	45	66.7	12	16.7	12	16.7			Functional
31	Insect nets	34	49.3	35	50.7					Functional
32	Thermometers	34	49.3	35	50.7					Functional
33	Bell jars	6	8.3	17	25.0	45	66.7			Not Functional
	HUMAN RESOURCES									
34	Teachers	35	50.7	34	49.3					Functional

35	Laboratory Assistants	29	41.7	40	58.3	Functional
36	Students	17	25.0	52	75.0	Functional

Table 4.7 above shows the frequencies and percentages of the respondents as regards to the functionality of biology laboratory resources in public secondary schools in Minna metropolis. It is made up of thirty-six (36) items. Each item is judge functional and not functional with 50% as the decision rule.

Item 1 has frequency of 12 respondents representing 16.7% responded strongly agreed, frequency of 35 respondents representing 50.0% responded strongly agreed, frequency of 35 respondents representing 50.7 responded agreed and frequency of 24 respondents representing 33.3% responded disagreed, thus item 1 is considered functional. Item 2 has frequency of 6 respondents representing 8.3% responded strongly agreed and frequency of 63 respondents constituting 91.7% responded agreed, thus item 2 is functional. Item 3 has frequency of 5 respondents representing 16.7% responded strongly agreed, frequency of 42 respondents representing 58.3% responded agreed and frequency of 12 respondents with 25.0% responded strongly disagreed, thus item 3 is considered functional. Items 4 and 13 have frequencies of 57 respondents each representing 83.3% responded disagreed and frequency of 12 respondents representing 16.7% responded strongly disagreed, thus items 4 and 13 are not functional. Item 5 shows frequency of 12 respondents with 16.7% responded strongly agreed, frequency of 52 respondents constituting 75.0% responded agreed and frequency of 6 respondent constituting 8.3% disagreed, thus item 5 is functional. Item 6 shows frequency of 64 respondents representing 92.8% responded disagreed and frequency of 5 respondents constituted 7.2% responded strongly disagreed, thus item 6 is not functional. Item 7 shows frequency of 35 respondents representing 50.7% responded strongly agreed and frequency of 34 respondents representing 49.3% responded agreed. Thus, item 7 is

considered functional. Item 8 shows frequency of 45 respondents representing 66.7% responded strongly agreed, frequency of 12 respondents representing 16.7% responded agreed and frequency of 12 respondents representing 16.7% responded disagreed, thus item 8 considered functional. Item 9 shows frequency of 35 respondents representing 50.7% responded disagreed and frequency of 34 respondents representing 49.3% responded strongly disagreed. Thus, item 9 is considered not functional. Item 10 shows frequency of 52 respondents representing 75.0% responded strongly agreed, frequency of 12 respondents representing 16.7% responded agreed and frequency of 6 respondents representing 8.3% responded disagreed. Thus, item 10 is considered functional. Items 11,16,28,31 and 32 show frequencies of 34 respondents each representing 49.3% responded strongly agreed and frequencies of 35 respondents representing 50.7% responded agreed respectively, thus items 11,16,28,31 and 32 are considered functional. Items 15,20,24,25 and 34 show frequencies of 35 respondents each representing 50.7% responded strongly agreed and frequencies of 34 respondents representing 49.3% responded agreed respectively, thus items 15,20,24,25 and 34 are considered functional. Item 12 has frequency of 40 respondents constituting 58.3% responded strongly agreed, frequency of 12 constituting 16.7% responded agreed and frequency of 17 respondents constituting 25.0% responded disagreed, thus item 12 is considered functional. Item 14 has frequency of 63 respondents representing 91.7% responded disagreed and frequency of 6 respondent constituting 8.3% responded strongly disagreed, thus item 14 is considered not functional. Item 17 has frequency of 12 respondents constituting 16.7% responded strongly agreed, frequency of 17 respondents constituting 25.0% responded agreed, frequency of 23 respondents constituting 33.3% responded disagreed and frequency of 17 respondents representing 25.0% responded strongly disagreed, thus item 17 is considered not functional. Items 18, 29 and 35 show frequencies of 18

respondents each representing 41.7% responded strongly agreed and frequency of 40 respondents representing 58.3% responded agreed, thus item 18, 29 and 35 are considered functional. Item 19 have frequency of 40 respondents representing 58.3% responded strongly agreed and frequency of 21 respondents representing 41.7% responded agreed, thus item 19 is considered functional. Item 21 shows frequency of 46 respondents representing 66.7% responded strongly agreed and frequency of 22 representing 33.3% responded agreed, thus item 21 is considered functional. Item 22 shows frequency of 22 respondents representing 33.3% responded strongly agreed and frequency of 46 representing 66.7% responded agreed, thus item 22 is considered functional. Item 23 and 30 show frequencies of 46% respondents each representing 66.7% responded strongly agreed, frequency of 12 respondents representing 16.7% responded and frequency 12 respondents representing 16.7% responded disagreed, thus items 23 and 30 are considered functional. Item 26 have frequency of 12 respondents representing 16.7% responded strongly agreed, frequency of 12 representing 16.2% responded agreed and frequency of 45 representing 66.7% respondents responded disagreed, thus item 26 is considered not functional. Item 27 have frequency of 40 respondents representing 58.3% responded strongly agreed and frequency of 29 representing 41.7% responded agreed, thus item 27 is considered functional. Item 33 have frequency of 6 respondent representing 8.3% responded strongly agreed, frequency of 17 representing 25.0% responded agreed and frequency of 46 representing 66.7 respondents responded disagreed, thus item 33 is considered not functional. Item 36 have frequency of 17 respondents representing 25.0% responded strongly agreed and frequency of 52 representing 75.0% responded, thus item 18 is considered functional.

Judging from the result above, items 4,6,9,13 and 14 represented high percentage in non functionality as reported by the respondents thus considered not functional while the rest items are functional as they are represented by 50% and above in functionality.

4.8 SECTION F: Biology Laboratory Resource Maintenance Assessment Scale (BLRMAS)

Biology laboratory resources are effectively maintained in my school.

Table 4.8 Frequency Table on Biology Laboratory Resource Maintenance Assessment Scale

A: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/N	MANAGEMENT STRATEGIES ON	SA		A		D		SD		Decision
	MATERIAL RESOURCES	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	
1	Constant cleaning of used materials	17	25.0	46	66.7	6	8.3			Maintained
2	Appropriate storage o f used materials	17	25.0	52	75.0					Maintained
3	Proper handling of la boratory materials	12	16.7	57	83.3					Maintained
4	Avoidance of vandali zation of laboratory materials	12	16.7	57	83.3					Maintained
5	Proper repair of faulty materials	12	16.5	12	16.5	45	66.7			Not Maintained
6	Improvisation of materials	35	50.7	34	49.3					Maintained
7	Replacement of damaged laboratory materials	12	16.5			51	75.0	6	8.3	Not Maintained
8	Being safety cautious in the laboratory	17	25.0	52	75.0					Maintained
9	Constant monitoring of usage materials	12	16.5	45	66.7	12	16.7			Maintained
10	Proper documentation of laboratory materials	34	49.3	17	25.3	17	25.3			Maintained
	HUMAN RESOURCES									
11	Training of staff and students	17	25.3	12	16.7	40	58.3			Not Maintained

12	Planning implementation and monitoring of BLR			57	83.3	12	16.7			Maintained
13	Organizing students during laboratory practicals	34	49.3	35	50.7					Maintained
14	Punctuality and regularity of staff and students to practical classes	12	16.7	45	66.7	12	16.7			Maintained
15	Prompt supervision of staff and students	4	5.8	12	17.4	53	7.8			Not Maintained
16	Judicious payment of practical dues by parents through PTA					69	100			Not Maintained
17	Acceptance of biology laboratory responsibilities by staff and students	11	15.9	58	84.1					Maintained
18	Prompt payment of salaries	33	47.8	36	52.2					Maintained
19	Avoidance of excessive duplication of practical works	29	42.0	25	36.2	15	21.7			Maintained
20	Giving awards to deserving staff and students			3	4.3	57	82. 6	9	13.0	Not Maintained
21	Controlling and counseling of staff and students	7	10.1	43	62.3	19	27.5			Maintained
22	Evaluating laboratory human and material adequacy	2	1.4	51	73.9	16	23.2			Maintained

Table 4.8 above shows the frequencies and percentages of the respondents as regards to the maintenance level of biology laboratory resources in public secondary schools in Minna metropolis. It is made up of twenty-two (22) items. Each item is judged maintained and not maintained with 50% as the decision rule.

Item 1 shows frequency of 17 respondents representing 25.0% responded strongly agreed, frequency of 46 respondents constituting 66.7% responded agreed and frequency of 6 respondent representing 8.3% responded disagreed, thus item 1 is considered maintained. Item 2 has frequency of 17 respondents representing 25.0%

responded strongly agreed and frequency of 52 respondent constituting 75.0% responded agreed, thus item 2 is considered maintained. Items 3,4 and 17 has frequencies of 12 respondents each representing 16.7% responded strongly agreed and frequency of 57 respondents constituting 83.3% responded agreed, thus items 3,4 and 17 are considered maintained. Item 5 has frequency of 12 respondents representing 16.7% responded strongly agreed, frequency of 12 respondents constituting 16.7% responded agreed and frequency 8 respondents representing 66.7% responded disagreed, thus items 3,4 and 17 are considered maintained. Item 6 shows frequencies of 35 respondents each representing 50.7% responded strongly agreed and frequency of 34 respondents constituting 49.3% responded agreed, thus item 6 is considered maintained. Item 7 has frequency of 12 respondents representing 16.7% responded strongly agreed and frequency of 51 respondents constituting 83.3% responded disagreed and frequency of 6 respondents constituting 8.3%, thus item 7 considered not maintained. Item 8 has frequency of 17 respondents each representing 25.0% responded strongly agreed and frequency of 52 respondents constituting 75.0% responded agreed, thus item 8 is considered maintained. Item 9 has frequency of 12 respondents representing 16.7% responded strongly agreed, frequency of 45 respondents constituting 66.7% responded agreed and frequency of 12 respondents representing 16.7% responded disagreed, thus item 9 is considered maintained. Item 10 has frequency of 34 respondents representing 49.3% responded strongly agreed, frequency of 17 respondents constituting 25.3% responded agreed and frequency of 17 respondents constituting 25.3% responded disagreed, thus item 10 is considered maintained. Item 11 shows frequency of 17 respondents representing 25.3% responded strongly agreed, frequency of 12 respondents constituting 16.7% responded agreed and frequency of 40 respondents represent 58.3% responded disagreed, thus item 11 is considered not

maintained. Items 12 shows frequency of 57 respondents representing 83.3% responded agreed, frequency of 12 respondents constituting 16.7% responded disagreed, thus item 12 is considered maintained. Item 13 shows frequency of 34 respondents representing 49.3% responded strongly agreed and frequency of 35 respondents constituting 50.7% responded agreed, thus item 13 considered maintained. Item 14 shows frequency of 12 respondents representing 16.7% responded strongly agreed, frequency of 45 respondents constituting 66.7% responded agreed and frequency of 12 representing 16.7% responded disagreed, thus item 14 is considered maintained. Item 15 have frequency of 4 respondents representing 5.8% responded strongly agreed, frequency of 12 respondents representing 17.4% responded agreed and frequency of 53 respondents representing 76.8% responded disagreed thus item 15 is considered not maintained. Item 16 have frequency of 69 respondents representing 100% responded disagreed, thus item 16 is considered not maintained. Item 17 shows frequency of 11 respondents representing 15.9% responded strongly agreed and frequency of 58 respondents constituting 84.1% responded agreed, thus item 17 is considered maintained. Item 18 shows frequency of 33 respondents representing 47.8% responded strongly agreed and frequency of 36 respondents constituting 52.0% responded agreed, thus item 18 considered maintained. Item 19 shows frequency of 29 respondents representing 42.0% responded strongly agreed, frequency of 25 respondents constituting 3.2% responded agreed and frequency of 15 responded representing 21.7% responded disagreed, thus item 19 considered maintained. Item 20 have frequency of 3 respondents representing 4.3% responded agreed, frequency of 57 respondents representing 82.6% responded disagreed and frequency of 9 respondents representing 13.0% responded strongly disagreed, thus item 20 is considered not maintained. Item 21 shows frequency of 7 respondents representing 10.1% responded strongly agreed, frequency of 43

respondents constituting 62.3% responded agreed and frequency of 19 respondents representing 27.5% responded disagreed, thus item 21 considered maintained. Item 22 shows frequency of 2 respondents representing 1.4% responded strongly agreed, frequency of 51 respondents constituting 73.9% responded agreed and frequency of 16 respondents representing 23 thus item 13 considered maintained.

4.9 Discussion of findings

The result of the study revealed that there are biology laboratory facilities in public secondary schools in Minna metropolis in which majority of the schools has specific biology laboratory facility and few uses multipurpose science laboratory for conducting biology practicals. The biology laboratory has enough space to accommodate students and is always open for students to carry out practicals. This agrees with Ukaegbu (2012) who reported that most biology laboratory resources are available in biology departments of colleges of education in south eastern Nigeria. Some of these resources include chalkboards, charts, models, textbooks, prepared slides, bulletin boards, chemicals, beakers, microscopes, flasks, fire extinguishers, text tubes, thermometers, lecturers and students while refrigerators, incubators, drying oven, laboratory technologists, radios and videotaped instruction not available. The result disagrees with the findings of Muhammad (2017) who reported that most senior secondary schools in Sokoto State have no laboratories and where they exist, they are poorly equipped. It was further reported that there are very few schools with special laboratories for each of the science subjects while others uses one general laboratory for all the core science subjects (Chemistry, Physics and biology). This also go inline with the findings of Anyadiegwu (2018) who carried out a study on availability and utilization of laboratory resources in teaching and learning biology in Enugu and reported that sixteen out of the twenty listed items were available among which is the biology laboratories.

The results of the study also revealed that biology laboratory resources are adequately provided except items like incubator, drying oven, projector, refrigerator, and autoclave which are not available while others are available in public secondary schools in Minna metropolis. This result is in contrast to the study submitted by Adeyemi (2018) whose study result shows that teaching resources, such as facilities, equipment, apparatus and personnel needed for effective learning process of biology are not sufficiently available in secondary schools. This goes with the findings of Anyadiegwu (2018) which revealed that laboratory resources are not adequately provided for in secondary schools. Again, the study revealed that biology laboratory resources in public secondary schools in Minna metropolis are functional except few of the items that are not provided. This is against the findings of Muhammad (2017) whose study indicated that most senior secondary schools in Sokoto State have no laboratories. Where they exist, they are poorly equipped and maintained. The study also shows that the biology laboratory resources in Minna metropolis are maintained except that there is no proper repair of damaged materials, no replacement of damaged materials, no training of staff and students, no payment of laboratory dues and there is no award giving to deserving staff and students. This is correlated with the report of Ukaegbu (2014) that giving awards to deserving staff and students, appropriate storage of materials; avoidance of excessive duplication of courses; evaluating resources; prompt repair/replacement of faulty materials and prompt supervision of biology laboratory resources are among the best strategies towards curbing factors militating against effective provision and management of biology laboratory resources in colleges of education in south eastern Nigeria Contrary to this report, Tolessa, Baressa, Bula, Oda & Itefa (2016) submitted that all respondents (100%) from Kilenso School respond as there is no laboratory room while majority of respondents (80.2%) from Bule Hora School respond as they have

common laboratory for each science and no separate laboratory for Secondary and Preparatory school. In all schools there is no facility, equipments and chemicals are simply stored in non-ventilated laboratory room due to absence of skilled laboratory technicians and even no cooling system.

CHAPTER FIVE

5.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This present an overview of summary of major findings, conclusion and recommendations

5.1 Summary of Major Findings

The study is a survey research which investigated the availability, adequacy, functionality and maintenance of biology laboratory resources in public secondary schools in Minna metropolis. There are five specific objectives and five research questions were raised to help the study. The study uses questionnaire as tool for data collect. Literatures were reviewed under conceptual work, theoretical work and empirical studies. The tool for study contained 138 items which was divided into six sections. It was validated and trial tested for reliability. Data were analyzed using frequency and percent table. The result of the findings indicated that there are biology laboratories in public secondary schools in Minna metropolis. Biology laboratory resources are available for conducting biology practicals in Minna metropolis, though modern laboratory resources like incubator, drying oven, projector, refrigerator, and autoclave are not available. The study also revealed that the laboratory facilities available are adequate, functional and maintained in public secondary schools in Minna metropolis. There is no proper repair of damaged materials, no replacement of damaged materials, no training of staff and students, no payment of laboratory dues and there is no award giving to deserving staff and students.

5.2 Implication of the study

The implication of this study is that laboratory resources mostly the modern resources that are not provided have effects on biology learners' content achievement thus result in an inability cope in future when it come practical application.

5.3 Conclusion

The importance of biology laboratory resources cannot be over-emphasized in teaching of biology in secondary schools. The availability of resources instructional facilities, equipment and supplies as well as adequate personnel motivates the Learners and increases their level of retentions. From the foregoing, it is concluded that there is biology laboratory facility public secondary schools in Minna metropolis. The biology laboratories are supplied with the required resources but lack modern electrical equipments. The biology laboratories resources in public secondary schools are adequate. The biology laboratory resources in public secondary schools in Minna metropolis are functional. Again, the biology laboratory resources in public secondary schools in Minna metropolis are well maintained.

5.4 Recommendations

Based on the findings, the following recommendations were made:

1. Modern electronic biology laboratory resources like incubator, drying oven, projector, refrigerator, and autoclave through the parents teachers association (PTA);

2. Prompt repair and replacement of damage materials be done through payment of laboratory dues;

3. There should be routine maintenance service of the biology laboratory resources by the laboratory assistants, teachers and students.

4. There should be awards to deserving staff and students through the school management to motivate them.

5.5 Suggestions for Further Studies

The findings and experience of the researcher necessitate the following suggestions for further studies.

1. Further studies should be undertaken to bring about effective program to which this work is deficient.

2. Students' perception on biology practicals in any level of learning.

3. The same study topic and method can be applied in other areas.

4. Further research is required on how to make the quality of biology practical's worthwhile in order to implement better and more efficient practices.

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APPENDIX A

QUESTIONNAIRE

LETTER TO THE RESPONDENTS

Department of Science Education,

School of Science and Technology Education,

Federal University of Technology, Minna,

Niger State.

20th August, 2019.

Dear Respondent,

Questionnaire on Assessment of Laboratory Resources for Conducting Biology Practicals in Secondary Schools (QALRCBPSS)

I am an undergraduate student of the above named institution carrying out a research work on the Assessment of Laboratory Resources for Conducting Biology Practicals in Secondary Schools in Minna Metropolis. Could you please help me by filling the attached questionnaire?

The information sought from you will be used purely for academic work. There is no right or wrong answers. Be assured that all the information given will be treated confidentially.

Thanks in anticipation of your assistance.

SECTION A: BIO-DATA

Please tick (✓) in the column that best expresses your opinion.

1. Name of the school.....
2. Gender: Male [ ], Female [ ]
3. Teaching qualification(s): OND [ ], HND [ ] NCE [ ], B.SC [ ], M.ED. [ ], B.TECH [ ], PH.D. [ ].
4. Teaching experience: Less than 2 years [ ], 3.5 years [ ], 5-10 years [ ], 11 years and above [ ].

SECTION B: Availability of Biology Laboratory Facility for Conducting Biology Practicals in Public Secondary Schools (ABLFCBPPSS)

(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/N	QUESTIONS	SA	A	D	SD
1	There is a biology laboratory in my school.				
2	The biology laboratory is also used to conduct physics, chemistry and agric. Practicals.				
3	The biology laboratory is large enough to accommodate students while carrying out practicals.				
4	The biology laboratory is always open for students to carry out pracicals.				

SECTION C: Biology Laboratory Resources Availability Assessment Inventory (BLRAAI)

What laboratory resources are available for conducting biology practicals in biology laboratories of public secondary schools in Minna metropolis?

S/NO.	MATERIAL RESOURCES	AVAILABILTY PROFILE	
		YES (AVAILABLE)	NO (NOT AVAILABLE)
1	Microscopes		
2	Hand lens		
3	Interactive boards (white, black, etc.)		
4	Incubators		
5	Filter papers		
6	Drying oven		
7	First aid box		
8	Weighing balances		
9	Projector		
10	Prepared slides		
11	Real objects		
12	Water baths		
13	Centrifuges		
14	Refrigerators/freezers		
15	Pipettes/burettes		
16	Measuring cylinders		
17	Autoclave		
18	Chemicals		
19	Reagent bottles		
20	Beakers		
21	Bunsen burners/ Stove		
22	Conical flasks/ Vacuum flasks		
23	Dissecting kits		
24	Litmus papers (white, blue, red)		
25	Fire extinguisher		
26	Desiccators		
27	Test tubes		
28	Petri dishes		

29	Retort stand		
30	Wire gauze		
31	Insect nets		
32	Thermometers		
33	Bell jars		
	HUMAN RESOURCES		
34	Teachers		
35	Laboratory Assistants		
36	Students		

SECTION D: Adequacy of Biology Laboratory Resources Provision Inventory (ABLRPI)

Biology laboratory resources are extensively provided for in my school.

(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/NO	MATERRIAL RESOURCES	EXTENT OF PROVISION			
		SA	A	D	SD
1	Microscopes				
2	Hand lens				
3	Interactive boards (white, black, etc.)				
4	Incubators				
5	Filter papers				
6	Drying oven				
7	First aid box				
8	Weighing balances				
9	Projector				
10	Prepared slides				
11	Real objects				
12	Water baths				
13	Centrifuges				
14	Refrigerators/freezers				
15	Pipettes/burettes				
16	Measuring cylinders				
17	Autoclave				
18	Chemicals				
19	Reagent bottles				
20	Beakers				
21	Bunsen burners/ Stove				
22	Conical flasks/ Vacuum flasks				
23	Dissecting kits				
24	Litmus papers (white, blue, red)				
25	Fire extinguisher				
26	Desiccators				
27	Test tubes				
28	Petri dishes				
29	Retort stand				
30	Wire gauze				

31	Insect nets				
32	Thermometers				
33	Bell jars				
	HUMAN RESOURCES				
34	Teachers				
35	Laboratory Assistants				
36	Students				

SECTION E: Functionality of Biology Laboratory Resources (FBLR)
Biology laboratory resources are extensively functional in my school.

(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/NO	MATERRIAL RESOURCES	EXTENT OF PROVISION			
		SA	A	D	SD
1	Microscopes				
2	Hand lens				
3	Interactive boards (white, black, etc.)				
4	Incubators				
5	Filter papers				
6	Drying oven				
7	First aid box				
8	Weighing balances				
9	Projector				
10	Prepared slides				
11	Real objects				
12	Water baths				
13	Centrifuges				
14	Refrigerators/freezers				
15	Pipettes/burettes				
16	Measuring cylinders				
17	Autoclave				
18	Chemicals				
19	Reagent bottles				
20	Beakers				
21	Bunsen burners/ Stove				
22	Conical flasks/ Vacuum flasks				
23	Dissecting kits				
24	Litmus papers (white, blue, red)				
25	Fire extinguisher				
26	Desiccators				
27	Test tubes				
28	Petri dishes				
29	Retort stand				
30	Wire gauze				
31	Insect nets				
32	Thermometers				
33	Bell jars				
	HUMAN RESOURCES				

34	Teachers				
35	Laboratory Assistants				
36	Students				

SECTION F: Biology Laboratory Resource Maintenance Assessment Scale (BLRMAS)
Biology laboratory resources are effectively maintained in my school.
(SA: Strongly Agree; A: Agree; D: Disagree and SD: Strongly Disagree)

S/NO	MANAGEMENT STRATEGIES ON	EXTENT OF AGREEMENT			
	MATERIAL RESOURCES	SA	A	D	SD
1	Constant cleaning of used materials				
2	Appropriate storage of used materials				
3	Proper handling of laboratory materials				
4	Avoidance of vandalization of laboratory materials				
5	Proper repair of faulty materials				
6	Improvisation of materials				
7	Replacement of damaged laboratory materials				
8	Being safety cautious in the laboratory				
9	Constant monitoring of usage materials				
10	Proper documentation of laboratory materials				
	HUMAN RESOURCES				
11	Training of staff and students				
12	Planning implementation and monitoring of BLR				
13	Organizing students during laboratory practicals				
14	Punctuality and regularity of staff and students to practical classes				
15	Prompt supervision of staff and students				
16	Judicious payment of practical dues by parents through PTA				
17	Acceptance of biology laboratory responsibilities by staff and students				
18	Prompt payment of salaries				
19	Avoidance of excessive duplication of practical works				
20	Giving awards to deserving staff and students				
21	Controlling and counseling of staff and students				
22	Evaluating laboratory human and material adequacy				

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