RELATIONSHIP AMONG ADEQUACY, UTILIZATION OF LABORATORY FACULTIES AND ACADEMIC ACHIEVEMENT OF BIOLOGY SECONDARY SCHOOLS STUDENTS IN TARABA STATE, NIGERIA

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A THESIS SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL AND LIFE SCIENCES EDUCATION, SCHOOL OF TEHNOLOGY AND SCIENCE EDUCATION, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN BIOLOGY EDUCATION, MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY, YOLA

DECEMBER, 2019

DECLARATION

I hereby declare that this project thesis was written by me and it is a research of my own research work. It has not been presented before in my previous application for a higher degree. All references cited have been acknowledged.

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BOYI Khason Joseph Date

DEDICATION

This thesis is dedicated to Boyi's entire family.

APPROVAL PAGE

This thesis "Relationship Among Adequacy, Utilization and Academic Achievement of Biology Secondary Schools Students in Taraba State, Nigeria" meets the regulations governing the award of Master degree of the Modibbo Adama University of Technology, Yola and is approved for its contribution to knowledge and literary presentation.

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TABLE OF CONTENTS

ABSTRACT

This study focused on the relationship among adequacy, utilization of Biology laboratory facilities and students academic achievement in Biology of Secondary Schools Students in Taraba State. Three research questions and three null hypotheses guided the study. The null hypotheses formulated and tested at 0.05 level of significance. Correlational survey design was adopted and sample of all students in senior secondary schools in Taraba North Geopolitical Zone, their teachers and examination officers from Taraba North Geopolitical Zone were used for the study, and purposive sampling of schools was used for selection of the schools with Biology single purpose laboratories, because some schools had general or multipurpose laboratories; while others have no laboratory at all. A population of 4635 SS3 students studying Biology was used, where 247 sample were the participant of this study. Instrument of the study was Biology checklist with 50 items on adequacy and utilization of Biology laboratory equipment and proforma for Biology achievement that were used for data collection. Descriptive statistic was used in answering research questions. To test the hypotheses, linear regression analysis was used in testing hypotheses one and two while hypothesis three, multiple regression analysis was employed. The result of the study revealed that Biology laboratory facilities was slightly adequate (with 2.36 Grand mean, and 0.88 as standard deviation) and utilization of Biology laboratory facilities was also slightly utilized (with 2.27 Grand mean and 0.97 as standard deviation) and was significant to students' academic achievement in Biology. The computed value of hypothesis one ($r = 0.81$; $p < 0.05$) showed that adequacy of Biology laboratory facilities significantly correlate with students academic achievement. Hypothesis two computed value ($r = 0.745$; $p < 0.05$), showed that utilization of Biology laboratory facilities correlated significantly with students academic achievement. Hypothesis three computed value ($r = 0.82$; $p < 0.05$), showed that adequacy and utilization of Biology laboratory facilities correlated significantly with students academic achievement in secondary schools in Taraba State. This means that there significant positive relationship among adequacy, utilization of laboratory facilities and students academic achievement in Biology. Based on the findings of the study, it was recommended among others that Biology laboratory facilities should be well provided with relevant and modern facilities for effective teaching and learning to meet up with the 21st century demands. This will go along to ensure that students will do practical Biology instead of learning about it theoretically.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Biology laboratory facilities are key to both teachers and students who will have full control over the facilities once in the laboratory. Provision of Biology laboratory facilities becomes necessary as their use will offer students the opportunity to develop scientific mind, skills, observation, creativity, and critical thinking. Some laboratory facilities are not like plants and animals, so they may not be found outside the laboratories. Such include among others chemicals, reagents, and equipment. There is need to have such facilities stocked (available) in Biology laboratory in adequate number for teaching the subject (Asiyai 2012) Biology as a key science subject is offered by most senior secondary schools, and so students of the subject are studying it. For the Biology teachers to perform their function in the teaching of the subject in the laboratory during practical, they needs those laboratory facilities to be available for both themselves and students so as to use them appropriately to improve students' performance especially in the external examinations (Hofstein & Lunetta, 2003). However, in contrast to this; students often complain of non-familiarization with Biology laboratory facilities because until few weeks to the external examination, students are not exposed to the facilities. In fact, even the teachers of the subject do not use laboratory facilities until during external examinations (Okafor, 2014; Crescentia & Amos, 2011).

Eriba and Samba (2011) state that education in the largest sense of its application, is any act or experience that has a formative effect on the mind, character or physical ability of an individual. In its technical sense then education is the process by which society deliberately transmits its accumulated body of knowledge, skills and values from one generation to another. If that is the case, education is the primary agent of transformation towards sustainable development since it increases individuals' capacities to transform their visions into reality (Mlozi, Kaguo & Nyamba, 2013). Not only that, the international community now strongly believes that education helps to promote the values, behavior and life styles required for a sustainable future (Eriba & Samba, 2011). If that is the case, how can one realize the outcome of educational objectives that can sustain future life? This can only be realized if facilities needed for learning are provided. Mlozi, Kaguo and Nyamba (2013) believe that most students perform better with regard to the rate of learning and motivation

for further learning when favourable learning conditions are provided to them. Learning in this case; can then be seen as a process of how to make decisions that consider the long-term future of the economy, ecology and equity of all communities.

Education as a concept, also refers to the process in which students are instructed, and taught to acquire or learn specific knowledge, skills or abilities that can be applied to real life situations upon completion. In this case it has become fashionable to divide education into different learning "modes" as visual mode which is the learning by the use of sight (eyes), auditory mode which is learning by the use of hearing (ears), and kinesthetic mode which is learning by the use of body manipulation (skin), otherwise which entails learning based on hands-on work and engaging in activities (Eriba & Samba, 2011).The implication of each mode of learning in biology is that, depending on the preferred learning modality, different teaching techniques have different levels of effectiveness where biology laboratory teaching and learning requires all the three modes. A consequence to the teaching outcome is that effective teaching should present a variety of teaching methods which cover all three modalities so that different students have equal opportunities to learn in a way that is effective for them. This becomes more crucial when one considers the teaching of a science subjects like Biology. Science teaching entails training the students to develop science process skills, adequate laboratory skills, attributes and ethics (Kpolovie,2014a). Therefore, there is need to provide a learning atmosphere that will help students to establish a sound knowledge base and skill as they are exposed to different life experiences. This means teaching must go beyond the talk and chalk method and it must involve the totality of the students. Here, learning must make use of more than two senses, example sense of touching/ feeling (skin), sense of smelling (nose), sense of hearing (ears), sense of seeing (eyes) and sense of tasting (tongue). Such learning requires hands-on, minds-on activities. There is no better place for such learning to be carried out than the laboratory (Eriba & Samba, 2011; Hofstein & Lunetta 2005). So the issue of using all the three modalities of learning corresponds to the three domains in education.

Mlozi, Kaguo and Nymba (2013) state that it is a universal truth that education empowers individuals cognitive, affective and psychomotor domains as a result of teaching and learning process, especially practical activities in order to deal with the multi-faced local, regional and global challenges to pursue a truly invigorating livelihood. Building the capacity for such futures-oriented thinking is a key task of education. On the contrary, science

teaching tends to emphasize cognitive domain alone, forgetting affective and psychomotor domains that involve the use of laboratory activities (Kpolovie, 2014a; Hofstein & Lunetta, 2003).

Castaldi in Peretemode (2001) opines that the expected and complete means of learning science is through divers orientations like laboratory practicals among others. Fatima, Semra, Ceren and Kahraman (2011) have pointed out that learning strategies such as discussion, and hands-on activities which improve students' performance and promote better science learning covering all the domains in education is what science teachers should be using. There is no better place to use all the domains than in the science laboratories, hence the laboratory becomes very necessary in learning Biology because it considers all individual differences (Kpolovie, & Ololube, 2013; Kpolovie, 2012a).Laboratory learning facilities experts say account for significant amounts of the variance of learning beyond that due to differences in students abilities. According to Eriba and Samba (2011), when one considers the nature of science in its totality as both product and process, which the students need to acquire in the course of studying sciences, Biology practical's activities in the laboratory become necessary. Yung (2000) posited that the laboratory becomes an essential component of science instruction because students are being exposed to both theory and practical learning processes. Hence, the laboratory should be a place where these activities are facilitated in specific ways (Lyons, 2012).

Hofstein and Lunetta (2003) suggested that while laboratory investigations offer important opportunities to connect science concepts and theories discussed in the classroom and in textbooks with observations of phenomena and systems, laboratory inquiry alone is not sufficient to enable students construct the whole learning process. Laboratory work they becomes necessary for the complex conceptual understandings of the contemporary scientific community, so using both theoretical and practical approaches in the laboratory makes it complete (Eriba & Samba, 2011). Stella (2009) explain that laboratory is an instructional facility used by the teacher to help students learn about science and how the scientists investigate the world around them. That is, laboratory is that school building set aside for scientific discovery and inquiry. Students are brought in direct contact with facilities and learn to manipulate them through procedures that reflect scientific thinking. The laboratory experience is meant to facilitate instruction and make learning more exciting, captivating and meaningful (Eriba & Samba, 2011).

Nigeria is operating new educational system generally known as 9-3-4 system of education with educational aims directed to society, in a bid to utilize an educational system which should be related to the aims and goals of Nigerian society. According to the Federal Republic of Nigeria (FRN), (2004) one of the aims of education is to inculcate creativity in the child. Here, teachers can aid creativity by stimulating students to discover their talents by respecting the originality and individuality of their students through inquiry emphasis. Teachers are to lead students from passivity to activity and also from imitation to creativity. The system is aimed at presenting science as a system of inquiry than just a body of knowledge. Learning in this orientation involves cognitive, affective and psychomotor domains and the better place to carry out such is the science laboratory. Here, practical activity takes the lead as all the domains in use will foster students acquisition of science process skills and eventually improve students' performance (Kpolovie, 2014).

Some researchers like Inyang, (2006), Andy and Sofeme (2012) recommended efforts on supply of laboratory facilities being expended on how to improve students' performance in science subjects. Adodo and Oyeniyi (2013) explained that the poor capital investment in terms of provision of science learning facilities contribute to students low level of academic performance. Andy and Sofeme (2012) found that students from Taraba State Senior Secondary Schools lacked science process skills, which has led to their inadequate state of science content learning hence their poor performance in Senior School Certificate Examination (SSCE) in science subjects. Also, a proforma from 2009-2013 of the West African Senior Secondary Certificate Examination (WASSCE) result of students grades extracted by the researcher from the Taraba State Ministry of Education, Jalingo, showed a fluctuating performance in Biology (See Appendix Biology WAEC Result pg. 77)

Biology curriculum for secondary schools as outlined in the 2008 curriculum document of Federal Ministry of Education (FME, 2009) was designed to prepare students to acquire adequate laboratory skills and. meaningful and relevant knowledge of biology so as to have ability to apply scientific knowledge in everyday life. In pursuance of the stated objectives, the curriculum emphasizes guided discovery, laboratory techniques and skills with conceptual thinking. The change in the global science curriculum is arising from explosion and new wave in science and technological development which demands qualitative science teaching. The change in the global science curriculum calls for the provision of learning facilities and utilization that enhance the effective teaching and learning of Biology practicals

and to achieve the national objectives and goals (FRN, 2013; Oludipe & Lasisi, 2006). With this therefore, when laboratory experiences are integrated with other meta- cognitive learning experiences such as predict-explain-demonstrations, practical activities and when they incorporate the manipulation of ideas with facilities and procedures, they can promote the learning of science (Lassen, Steele, & Sailor, 2006). Provision of Biology laboratory facilities become necessary as its use will offer students the opportunity to develop scientific knowledge and skills, become proficient in creativity, and critical thinking.

Adequacy of Biology laboratory facilities in secondary schools centers on the number of facilities recommended by West African Examination Council (WAEC).The supply of laboratory facilities by school or government authorities is based on such recommendation for effective teaching and learning of biology in secondary schools. The availability of facilities in science laboratory as well as available space for teachers and students give room for maximum efficacy in utilization (Samba & Eriba, 2011). Umeoduagu (2000); Hofstein and Lunetta (2005) pointed out that adequate facilities in science laboratories permits individual student freedom of learning as independent learner. This gives the learner better opportunity to acquire individual intellectual development. Umeh (2006) in a study showed that availability of laboratory facilities, such as apparatus and libraries have significant positive influence on the students performance and achievement. It is a common knowledge that the broad aims and expectations of any teaching and learning of science programme are productivity and positive evaluated end-product (achievement) that is positive outcome. But in recent times, observations on students academic achievement in science generally and Biology in particular from the results of Senior School Certificate Examination (SSCE) conducted by West African Examination Council (WAEC) and National Examination Council (NECO) revealed that very few number of students perform well in Biology examination compared with other subjects (Sofeme & Andy, 2012 and Adodo & Oyeniyi, 2013). Chukwuemeka, (2008); Chinweoke, (2010) in their different studies discovered that poor academic performance and low enrolment in science generally, and Biology in particular in Nigeria are caused by poor reading habit, negative students attitude/interest towards Biology, gender, inequalities, inadequate laboratory facilities, inadequate staff motivation, inadequate instructional materials and so on.

Idakwoji (2016) highlighted the poor academic achievement in Nigerian schools despite reported significant efforts to redress the failure yet the problem persists. The author

examined a key factor like laboratory learning facilities in the equation of students' educational achievement. Also, Adegbesan (2011) stated that problems of the education sector that most directly affect the teacher in biology laboratory teaching include congested classroom, dilapidated and insufficient structures and instructional facilities; which led to poor students academic achievement, indiscipline, cultism, examination malpractice and high incidence of students dropout. Also, Obomanu and Akporrewhe (2011) contributed laboratory facilities that the use of these facilities in teaching offers students the opportunity to develop scientific skills such as observation, objectivity, creativity, communication, and critical thinking. Despite the expected benefits of utilizing facilities in the teaching/learning process there has been consistent failure in students' performance in Biology in the WASSCE in Nigeria.

Science education is veritable learning ground for the scientific and technological advancement of any nation as posited by the American Association for Advancement of Science (AAAS), 1993).This fact is also contained in the National Policy on Education, Federal Republic of Nigeria (FRN, 2013), which stipulated that science education should be among the educational programme that students should be exposed to, so as to equip them with relevant knowledge and skills to enable them live effectively well in the modern age of science and technology. For this to be achieved, science facilities and technology facilities for teaching and learning of science should be adequately supplied and teachers should make judicious utilization of them in the educational sector so that the desired objective could be attained. The science facilities could be: biology laboratory facilities, chemicals, reagents ,specimens, models, diagrams/charts, dissecting kits and preserved plants and animals. Adodo and Oyeniyi (2013) contributed that the world is fast becoming scientific in thinking and behaviors that without good knowledge of science, it might be difficult for people to adequately function in it. The purpose of exposing students to science instruction right from primary school level is not necessarily to turn them into scientist per se but to provide favorable scientific attitudes of "finding out" through "hands-on" activities and to enable them raise questions about things that intrigue them, using science facilities or natures' facilities. Bello (2012) pointed out that more often than not, availability or inadequacy of suitable teaching facilities is blamed for the poor performance among other factors such as the teacher competency, teaching methodology and the attitude of the students towards the subject. Using adequate and suitable laboratory facilities to teach Biology secondary schools will help to improve the academic achievement of the students. Bello's view was supported

by evidence provided in the empirical study conducted on the utilization of suitable facilities in Biology laboratory which indicated that of influence students achievement in senior secondary schools Biology subject.

According to Umeh (2006), some facilities that can be used to improve the educational programme and promote teaching/learning process in Biology are: models, charts and preserved specimens. The laboratory facilities are those materials that are available in the laboratory that the teacher can use for the teaching and learning process. Also, Obomanu and Akporrewhe (2011), stated that those facilities and resources teachers use in teaching biology are models, charts, electronic devices like overhead projectors, computers. Others include incubators, thermometers, dissecting kits, fire extinguishers and oven as. Hofstein and Lunetta (2003), opine that the science laboratory, as a unique learning environment, is a setting in which students can work cooperatively in small groups to investigate scientific phenomena. The special environment in a school laboratory is usually less formal (it encourages free movement) than in a conventional classroom. Thus, the laboratory offers opportunities for productive and cooperative interactions among students with their teacher. The learning process depends markedly on the laboratory facilities and series of activities conducted in the laboratory. On the whole, science laboratories have made this world very advanced and scientific in its purposes through verifying principles, theories and laws (Crescentia, Sekegor & Agadaigho, (2013). Adodo and Oyeniyi (2013 state that poor academic performance and low enrolment in science generally, and Biology in particular in Nigeria are caused by many factors among others like: inadequate laboratory facilities, inadequate staff motivation, and inadequate instructional facilities.

Instructional theory of learning interaction, hypothesized that the laboratory facilities had a direct effect on both students' attitudes and academic performance. If that is the case, then laboratory facilities are linked with students' academic achievement in secondary schools (Bennett, 2003). Eshiet (2006) is of the belief that laboratory facilities make science teaching/learning more concrete and stimulating and therefore, better students' academic performance in secondary schools. Amboga, (2012) also added that laboratory facilities have significant positive influence on the students' performance and achievement. It is generally believed that constant practice leads to proficiency in what the learner learns during the theories in the normal classroom instruction; hence the saying practice makes perfect. This has given rise to the expectation that laboratory facilities should be adequately provided to

secondary schools for effective teaching/learning. The saying practice makes perfect here is talking about utilization of biology laboratory facilities during practical which some authorities like (Crescentia & Amos, 2011; Okafor, 2008) pointed out that most schools have not been doing. How can one link students' academic achievement to laboratory facilities that most schools do not have or have not been using them or to compare to those who have them. According to Adodo and Oyeniyi (2013), most science teachers do not usually find it convenient to make laboratory work as the centre of their instructions. Crescentia and Amos (2011) add that they complain of the class size in the urban schools as it is getting larger and so this does not usually encourage teachers to utilize the laboratory method to teach science especially Biology as available facilities would not go round the number of students during practical periods. Some teachers shy away from conducting practical activities with their students because of inadequate facilities in the laboratory (Idakwoji, 2016). Umar (2006), Hofstein and Naaman (2007) added that laboratory facilities that the laboratory and its facilities have been a distinctive feature in science teaching and learning. According to Musah and Umar (2017) for the students to learn science efficiently; laboratories should have adequate facilities for learning biology, if that is not done then teachers should endeavor to improvise the learning facilities in the laboratories. This is because teachers' preparation affects students learning and achievement in biology practicals, so the impact of teachers preparation on students learning and achievement in biology practical in some selected schools in Jalingo local government Area of Taraba State showed that students academic performance is significantly higher in schools with enough learning facilities, than in schools with low or no facilities (Thomas, 2013).

If laboratory facilities make science teaching more real, concrete and stimulate learners, hence they enhances students' academic performance in secondary schools as claimed by other authorities like Igboabuchi (2010).; Schustler,(2013) Eshiet (2006) then every school should endeavor to supply and use them when the need arises so as to improve students' academic achievement. Otherwise linking academic achievement of students with laboratory facilities serve little means. Other researchers' share the same view that adequacy of laboratory facilities which have a significant effect on the students' academic performance in Biology, in secondary schools science teaching and learning on students academic achievement is by chance, and so linking them with laboratory facilities is not proper at all (Aburime, 2004; Okafor, 2000). Another contributors on laboratory facilities though contrary to other authors are Umar (2006), Lavrenz (2006), Ihuarulam (2008), state that there are

inadequate laboratory facilities for teaching and learning of science subjects in public secondary schools in Nigeria. These authors further stated that where there are little facilities at all, they are not good, and few others that are in good condition are not enough to go round students' numbers. Also, the few available materials are not functional. This, give teachers good reason to complain of insufficient science learning facilities, and so do not observe practical periods. Some authors like Crescentia and Amos (2011), also have similar view that higher institutions in Nigeria that are charged with the responsibility of training science teachers at all levels of educations, are increasingly turning out the teachers without requisite laboratory training/experience. A common reason that is usually associated with the shortages of laboratory facilities, that trained science teachers usually lack the necessary competency/confidence to conduct the expected or required practicals of deserving topics with their students as claimed by (Inyang, 2006; Isaac, 2012). Such could be true with some teachers for they themselves were not given the training during their period in schools so their students' academic achievement in biology is only by chance.

Biology laboratory is not a newly wedded bridal-room that is for show or recreational purpose but biology laboratory facilities are for utilization in verifying principles, theories and laws about living things. According to Owino, Ahmad, and Alice (2014) commented that the purpose of the utilization of Biology laboratory facilities is to improve the quality of teaching and learning thereby helping in actualizing the objectives of the biology curriculum. The utilization of the laboratory facilities in teaching the subject by the teachers is not in good fate, but only to follow the curriculum designed for the subject (Lavrenz, 2006; Adodo & Oyeniyi, 2013; F M E, 2008)).

School laboratories have been described as organizations of where facilities are utilized, managed and organized in such a way that enables the student to acquire desirable learning competencies. The process of managing and organizing facilities is called facilities utilization. The utilization of laboratory facilities is essential for the effective teaching/learning of Biology and also improves students' performance as claimed by (Opara, 2008, Crescentia, Sekegor & Agadaigho, 2013). In contrast, there is said to be no significant correlation between utilization of science laboratory facilities and students' academic performance (Neji, 2011, Etiubon, 2010).

The utilization of facilities in teaching brings about fruitful learning since it stimulates students sense as well as motivating them Abiona and Olagunju (2008), opined that there are

varieties of facilities which the biology teacher can readily use to enrich learning. Some of the facilities are windvane, raingauge, models, and charts, preserved specimens of plants and animals, culturing equipment, herbarium, terrarium, vivarium, binocular camera, insects/sweeping nets, projectors and microscope. The facilities should be provided in quality and quantity in science technology and mathematics (S T M) classroom for effective teaching-learning process, that means locally made facilities will not brings about effective teaching and learning of biology (Abiona & Olagunju, 2008, Inyang, 2006).

Another view about teaching and learning of science using laboratory facilities that are not specific in terms of quality yet can bring about effective teaching and learning is by Hofstein and Lunetta (2005), who state that the school science laboratory continues to be perceived as a unique environment for teaching and learning science in a social setting that includes interactions with facilities and data, interactions between and among students, their teacher, and sources of expert information. Further, Hofstein and Lunetta (2003) observed that throughout their effort, researchers have continued to revealed that many science teachers do not utilize or manage this unique environment effectively. The level of adequacy of biology laboratory facilities and utilization of facilities in schools is important in the achievement of academic programme, goals and objectives. This is because the students learning outcome will be influenced through the use of appropriate school learning facilities and shortages in these facilities can hinder instruction and consequently lower students' performance (United Nation Education Scientific and Cultural Organization (UNESCO, 2007)

Andy and Sofeme (2012) noted that laboratory facilities are inadequate for biology, chemistry and physics in Taraba State senior secondary schools. Their study also indicated that there was no significant difference in the academic progress made in schools with adequate laboratory facilities and those without them. Thomas (2013), study revealed that students' academic performance is significantly based on teachers' preparation pathways and how teachers managed biology laboratory learning facilities to teach Biology in Jalingo, Taraba State. The researcher observed that Taraba State students academic achievement in biology in its senior secondary schools have been fluctuating due to inadequate facilities and usage WAEC Results from 2009-2013, (See Appendix p. 77). In view of this therefore, the study investigate adequacy and utilization of Biology laboratory facilities and students academic achievement in senior secondary schools in Taraba State.

1.2 Statement of the Problem

The international community like (UNESCO), National Association of Biology Teachers (NABT), American Association for the Advancement of Science (AAAS), United Nation (UN) recommended that individual countries have educational programme in place for capacity building of their nationals who can thereafter use the education gained for self and national development, and for them to live happy and productive lives.

The increasing failure rate that fluctuates from year to year in Biology in school examinations are worrisome. Observations and investigations on students performance in Biology in the SSCE showed that just a small percentage of students perform well in the examination when compared with other subjects in the same examination of the same year. Adodo and Oyeniyi (2013) also observed that in recent times, students academic achievement in science and Biology, in particular over the years is very discouraging. The results of West African Senior Secondary Certificate Examination (WASSCE) conducted by West African Examination Council (WAEC) and senior school certificate examination (SSCE) conducted by the National Examination Council (NECO) reveal that few students perform well in Biology examination compared with other science subjects. Adegbesan,(2011) and Idakwoji,(2016) tied students persistent poor performance in Biology to challenges that range from dilapidated and insufficient structures, out-of-date curriculum, and intra-institutional management problems to insufficient financial, inadequate facilities and skilled human resources.

Despite students' high rate of enrolment in Biology majority of them still perform poorly. The external examination results over the years reveal fluctuation in Biology students results (See Appendix 77). Therefore this calls for concern. However, not much has been achieved in bringing about the much needed improvement in the teaching and learning of Biology by students as their results in Biology continues to fluctuate as expressed by Adodo and Oyeniyi (2013) is similar to the study of Thomas (2013) which reported on the effect of teacher preparation and the use of Biology laboratory facilities during practicals, result revealed that students academic performance is significantly based on teachers preparation pathways and how teachers managed Biology laboratory learning facilities to teach Biology in Jalingo, Taraba State. Andy and Sofeme, (2012) in a study revealed that students from Taraba State senior secondary schools lack science process skills. This could stem from the non-comprehensive state of science content, that results from inadequate laboratory facilities

in teaching the students Biology subject, hence their poor performance in SSCE examination in Biology subject. This problem may be due to inadequate Biology laboratory facilities, or may be laboratory facilities are not used for its shortages/dysfunctional state by both teachers and students. If this is not addressed, Biology students would continue to have poor results, there will be no Biology students at advance levels and the country would not develop scientifically and otherwise. Given the foregoing educational problems, the study therefore sought to investigate the students' academic achievement based on the level of adequacy and utilization of Biology laboratory facilities in senior secondary schools in Taraba State.

1.3 Purpose of the Study

The purpose of this study was to investigate the relationship among the adequacy, utilization of laboratory facilities and academic achievement of Biology secondary schools in Taraba State, the specific objectives are to:

1. Determine the relationship between adequacy of biology laboratory facilities in relation to students' academic achievement in senior secondary schools in Taraba state.
2. Determine the relationship between level of utilization of biology laboratory facilities in relation to students' academic achievement in senior secondary schools in Taraba State.
3. Determine the relationship among levels of adequacy, utilization of Biology laboratory facilities in relation and student's academic achievement.

1.4 Research Questions

The following questions are raised to guide this study.

1. What is the level of adequacy of Biology laboratory facilities in senior secondary schools in Taraba State?
2. What is the level of utilization of Biology laboratory facilities in senior secondary schools in Taraba State?

1.5 Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

Ho_1: Adequacy of Biology laboratory facilities does not significantly correlate with student's academic achievement in Taraba State.

Ho_2: Utilization of Biology laboratory facilities does not significantly correlate with student's academic achievement in Taraba State.

Ho_3: Adequacy and utilization of Biology laboratory facilities do not significantly correlate with student's academic achievement in Taraba State.

1.6 Significance of the Study

The findings of the study would be of benefit to the secondary school students, Biology teachers, educational planners as well as researchers. Others are: School administrators, Taraba State ministry of education, Taraba state post primary management board, then the general public.

The findings of the study would be workable/practicable solution to problems associated with low performance of senior school students in Biology in national examinations. Result of the study may give clues to the public on the level of use by teachers/educators, Biology teachers of laboratory facilities in the teaching of Biology. Biologists recognize that knowledge based upon experimental results and accurate observations are gained through a variety of experiences. Thus, the role of the laboratory learning becomes a key component in understanding Biology study, as it provides students with opportunities to gain experiences in their quest for knowledge of living things.

The findings of this study would provide ground for further studies for future researchers. And more researchers expose their findings, in Biology to world of science and technology. The result would help the teachers to adjust, in their teaching of Biology; so also the governments that would provide the necessary Biology laboratory facilities to all the senior secondary schools. Further, research results may expose the state of Biology laboratory facilities in senior secondary schools in Nigeria.

Educational planners would benefit from this study having lay hands on the research results so as to adjust on students academic achievement in Biology external examinations. That may help the education planners on how to go about the supervision of Biology teachers from time to time, especially during the practical periods to every senior secondary schools in Taraba State.

The findings would inform the ministry of education of the necessity to organise educational meetings like: training programs, workshops and conferences for Biology teachers in order to improve on their methods of teaching Biology for better student's academic performance. The findings of this study would also go a long way in assisting the educationist in day to days' evaluation of Biology teaching process, and for further planning of better improvement on senior secondary schools in Nigeria.

The findings would be of benefit to Taraba state post primary management board on the posting of Biology teachers to schools that need such and laboratory technicians/assistants on how best to run the utilization, organization, management and services of Biology laboratory facilities in public schools. This may go along way in the supervision of Biology teaching process by the supervisors from Taraba State post primary management board.

The findings of this study would give the general public insight on the state of teaching and learning environment that our senior secondary schools are provided with in Taraba State, and how Biology laboratory facilities are being handled by Biology students, Biology teachers, Biology laboratory technicians/assistants in senior secondary schools in the State.

1.7 Scope of the Study

This study was restricted to Biology laboratory facilities, their level of adequacy and utilization and students' academic achievement in senior secondary schools in Taraba state. The study was delimited to only senior secondary school three (SS3) biology students and their Biology teachers. The SS3 students were chosen because such students have chosen their subjects for external examination or SS1 that have just been introduced to the subject (Biology) with little or not enough knowledge of Biology. The study was limited to correlational design. It was restricted to the use of checklist and proforma for data collection. The study analyzed the data using regressional analysis.

1.8 Operational Definition of Terms

The following terms were defined operationally as used in this study.

1. Adequacy of Biology Laboratory: Adequacy refers to WAEC recommendation of the number of each apparatus/equipments or specimens per student(s) or few number of students (in a group) during WAEC examination in the secondary schools laboratories being investigated.

2. Utilization: Utilization is the manipulation of a given Biology materials or grouping of specimens. It is the usage and management of science materials during Biology practical by secondary school teachers in Taraba State.

3. Biology Laboratory Facilities: Biology laboratory facilities are those materials/equipments that help in the study of Biology (devices/supporting services) and in the collection of living (aquatic organism using sweep-net) and non-living things (data collected through the use of items in the checklist/BLEIC), for biological studies.

4. **Academic Achievement:** The students' grade/score obtained in WAEC senior secondary school examinations in Biology.

5. Indoor Biology Laboratory: A room specially designed and equipped with services (water, electricity, gas) for practical studies in Biology.

CHAPTER TWO

LITERATURE REVIEW

This chapter contains the review of related literature. It was done under the following subheadings:

2.1 Theoretical Framework

The theoretical framework of this study was based on system theory which was propounded in the 1940 by Ludwig Von Bertalanffy (1968, Wikipedia, 2013). Von Bertalanffy states that "all system have different parts performing different functions but in such a way that each part interacts and is interdependent with other parts and with other system (Joslyn, 1992). Bertalanffy (1940) was both reacting against reductionism and attempting to revive the unity of science. According to Charlton and Andras, (2003) System theory focuses on the arrangement of and relations between the parts which connects them into a whole. System environment boundary, as: input, output, process, state, hierarchy, goal-directedness, and information. The systems theory is the process by which an organization generates a global representation of its own processes.

Federal Republic of Nigeria (FRN), (2004) state that secondary schools offer science, technical and vocational education programmes for the purpose of producing graduates required for the nations' scientific, economics as well as for technological development. In order to achieve this national goal, science and technology education has to be enshrined into the nation's education curriculum. The needed facilities to be used will serve as the input as outlined by system theory. The input needed should be available, adequate and utilized, and

such input facilities are the teachers, infrastructure and the laboratory facilities. Charlton and Andras (2003); Eriba and Samba (2011). The process being the actual teaching and learning as well as the activities that lead to meaningful learning. The output here refers the skills equipped students who is empowered to perform after graduation.

Hull (2001), Charlton and Andras (2003) this study is therefore in using the System Theory, is set to connects the adequacy and utilization of Biology facilities to students academic achievement, for effective learning, skills acquisition by students of senior secondary schools in Taraba State; as it try to find out the link between facility adequacy (input) and utilization as (teaching process) and students achievement as output or goal of education. Thus the theory relates the Biology laboratory facilities and the teaching as the input which are needed to be adequate and to be utilized for process that is the actual teaching and learning to take place as the output or what students are able to do after graduation is also output. Secondary schools offer science subject like Biology programmes for the production of the required outcome of the graduates for the nation, scientific, economic and technological development (Federal Republic of Nigeria FRN, 2004). The development of such outcome is based on System Theory, the theory connects the relationship among adequacy, utilization of Biology laboratory facilities and students' academic achievement in senior secondary school students in Taraba State. It is related to the theory as it try to assess how laboratory facilities affects students academic achievement. Here, the theory relates the facilities as the input materials for learning Biology which are needed in adequate number in the laboratory and to be utilized (also input) by both teachers and students so that teaching/learning take place as the output.

2.2 Concept of School Science Laboratory

All science laboratories have certain general features and requirements in addition to which each separate science has its own special demand which requires a special laboratory and facilities (Muhammad, 2017). The single-purpose; It is one which is designed and equipped for teaching only one science subject an example of this is the biology, chemistry, physics or integrated science laboratory. The biology laboratory for instance, would be designed and provided with equipment such as microscopes, specimens of living things such as well as animals and plants. A mini aquarium could also be a part of the laboratory provisions for teaching biology concepts.

The multi-purpose school science laboratory; as opposed to a single-purpose laboratory, multi-purpose laboratory is meant for teaching and learning more than one science subject. The laboratory is usually designed and equipped for the purpose of carrying out scientific experiments in more than one science subject, though not at the same time. Such laboratory could be seen in the same room microscopes and their accessories like weighing balance that are not necessarily for biology teaching, as well as specimens of living things and other items for physics teaching can also be seen there as well. This type of laboratory is necessitated by the paucity of funds by proprietors of schools to construct multi-purpose laboratory for their school. They often find it too costly and unaffordable to provide separate laboratories for teaching the different science subjects. Thus the multi- purpose school science laboratory is a common feature in many community/private proprietary schools in Nigeria. The special purpose science laboratory is one that is designed for research purposes. This type of the school science laboratory is found in the universities. Even at that, it is meant for postgraduate research students (Eriba & Samba, 2011)

Eriba and Samba (2011), when one consider the nature of science in its totality as both product and processes, which the students need to acquire in the course of studying sciences. The laboratory becomes an essential component of science instruction. Hence the laboratory should be a place where these activities are facilitated in specific ways, like verify principles, theories and laws, among others. Laboratory, it is no mean saying that the laboratory is the only sure place where meaningful science can be taught and learnt (Inyang, 2006). It absence in a school where science is presumably taught amounts to laxity on the part of the science teachers, this is because Muhammad (2017) posted that the condition under which many teachers functions does not engender any enthusiasm for practical work. The class size especially in urban school is getting larger. He further said there is a general increase in the environment of students who study Biology without a corresponding increase in school facilities. teachers and students now over utilized the facilities because of the pressure on them. Supporting this view Lewin (2000) reported that the importance attached to laboratory activities does not match government provision of laboratory facilities and equipment possibly due to the condition of the national economy which continue to deteriorate. Justifying this claimed Lewin (2000) further noted that in most states governments have given up the hope of adequate equipping all schools with science facilities. Multi-purpose, single subject laboratory or even a special laboratory, it is often advisable in the face of financial scarcity, to begin with a multi- purpose laboratory. However, where

there's adequate funding, single subject laboratories should be built as these would take care of the peculiarities of each subject, thereby giving room for maximum efficacy in utilization.

When used properly, the laboratory is especially important in the current era in which inquiry has re-emerged as a central style advocated for science teaching and learning national research council (Bajone, 2015). Lunetta and Hofstein (2005). In a review of 1982, they wrote that laboratory activities offer important experiences in learning science that are unavailable in other school disciplines. Chukwenmeka, (2008) In well over a century, laboratory experiences have been purported to promote key science education goals including the enhancement of students; Understanding of scientific concepts, Interest and motivation. scientific practical skills and problem solving abilities, scientific habits of mind (more recent). and understanding of the nature of science (more recent).

Inquiry empowering software can also provide scaffolding to support scientific practice and can be integrated into new inquiry practical like the use of overhead projectors (Reiser, Taback & Sanderal, 2001). These tools can also assist students in supporting assertions they are making about explanations and about relationships among variables with data-based evidence. (Stella, 2009). Inquiry is defined as the diverse ways in which students study the natural world and propose explanations based on the evidence derived from their work.

Ishtiaq, Qaiser, Naseer and Farhan (2017) also contributed on the use of technology facilities that, it involve getting students to carry out investigation of natural phenomena through which meaningful problems are answered and new knowledge obtained. Inquiry based teaching approach provides useful platform for engaging students in practical hands-on- science aspects investigations that can bring them in interaction with living and non-living aspects of the environment (George, 2003). Students are able to explore materials, design investigation for testing hypotheses and work with data with the teachers supporting to identify and interpret patterns (Kpolovie, 2014).

Practical exercises in science give student the chance to directly use materials, manipulate objects or physical materials, observe or explore the characteristics of objects and materials engage in-depth investigations and draw meanings from experiences. Handle real life experiences. Students can have direct contact with, and physically handle materials and object. Bring experimental evidence to the learning of concepts. This is effective in promoting cognitive understanding and retention. For instance students learn how to do

dissecting live rabbit in order to identify organs than they could from a mere talk-and – chalk description. Learn basic laboratory procedure example making slides. preparing materials, preserving specimens (Chinweoke, 2010; Dinah, & Samikwo 2013).

Lunetta and Hofstein (2003), American Association for the Advancement of Science (A.A.A.S, 1993) posted that the design of science laboratory activities that focused on inquiry can provide interacting and manipulating learning opportunities that help students develop concepts and frameworks about science doing. To attain such important but demanding goals of education (objectives, skills and attitudes), the education system must provide time and opportunity for teachers to interact with their students and also time for students to perform and reflect on complex investigative tasks. Reluctance may also originate in the beliefs teachers hold about what students should be learning in laboratory experiences, how students learn. Okebukola and Oguniyi (1984) That when students are engaging in inquiry and practical work, and also how to engage them with different manipulative skills and knowledge in practical experiences that result in meaningful learning and how to promote a more effective laboratory learning environment.

AAAS,(1993); Hofstein and Lunneta, (2003); Dinah, and Samikwo, (2013).) Factors that continue to inhibit learning in school science laboratory include the following.

Many of the activities outlined for students in laboratory guides continue to offer cook-book lists of tasks for students to follow ritualistically. Assessment of students' practical knowledge and abilities and of the purposes of laboratory inquiry tends to be seriously neglected; even by high stakes tests that purport to assess science standards. Teachers and school administrators are often not well informed about what is suggested as best profess practice, and they do not understand the rationale behind such suggestions. Thus, there is a high potential for mismatch between a teachers rhetoric and practice that is likely to influence students perceptions and behaviors in laboratory work. Incorporating inquiry-type activities in school science is inhibited by limitations in resources (including access to appropriate technology tools) and by lack of sufficient time for teachers to become informed and to develops and implement appropriate science curriculum other inhibiting factors include large classes, inflexible scheduling of laboratory facilities, and the perceived foci of external examinations (Wabuke, 2013).

2.3 Concept of Academic Achievement in Biology

Academic achievement in school is evaluated in a number of ways. For regular grading students demonstrate their knowledge by taking written and oral tests, performing presentations, submission of homework and participating in class activities and discussion. Teachers evaluate in the form of assignment, test and examination to describe how well a student has done poor academic achievement is a performance that is adjudged by examine and some significant others as falling below an expected standard (Adesemowo, 2005). According to Achino (2010) achievement is the level of an individual's educational growth in a test when compared with the scores of others of the same level. General academic achievement means accomplishment or proficiency of performance in a given skill or body of knowledge. Maikano (2006) express the view that most important aspect of scientific achievement are those concerned with the development of knowledge and skill needed to make decision and social scientific and technological problems. In this students therefore, academic achievement of Biology student is considered.

Academic achievement in this work is in the context of learning and being able to express what has been learnt in a written or practical form without examination malpractice of any sort. It requires the capacity to retain propositional knowledge, to select from such knowledge appropriately in respect to a specified requires and to do so without reference to possible source of information.

Hence, academic performance is the demonstrated achievement of learning as opposed to the potential for learning and is measured validly with SSCE by NECO/NECO in Nigeria (Kpolovie, Ololube, & Ekwebelem, 2011). In the same vein, Lawton and Gordon further commented that academic achievement is the present attainment or learning of a particular skill or knowledge demonstrated by evidence of some kind, including performance in test. Academic performance is the achievement of a student in terms of aggregate obtained in a test or examination in specific subjects that covers a given academic programme.

Academic achievement can be defined as excellence in all academic disciplines, in class as well as extracurricular activities. Academic achievement is the outcome of education as it indicates the extent to which the student, teacher, curricular and indeed the educational institution has achieved the predetermined educational goals. Academic achievement is commonly measured with examination that assess important procedural

knowledge such as skills, and declarative knowledge such as facts which student have learnt (Engel;, 2002; Bennett, 2003).

A student's academic achievement is usually measured by teacher-made tests or standardized tests (Kpolovie, 2012) in most cases which are referred to as external examination like the SSCE conducted in Nigeria by the West African Examination Council (WAEC) and the National Examination Council (NECO) (Kpolovie, Ololube & Ekwebelem, 2011).

Aronson (2002) explained academic achievement as the degree of attainment by student in schools colleges and universities either in class, laboratory, project/thesis work in which the student is sufficiently exposed to. Also another contributor on this Anekwe (2006) see the achievement as test for the measurement and comparison of skills various fields of academic study. Hence achievement could be described as a task which has been accomplished successfully especially by means of exertion, skill practice or perspective. Academic achievement enables us to obtain information on the extent to which a student has attained the criterion performance. It also enables us to determine the relative position or work of individual student with respect to their performance (Euk, Koko, & Eno, 2011).

Academic achievement refers to a person's performance in a given academic area like reading Biology and other areas of human learning. Academic achievement relates to academic subjects a child studies in class/school and the skills the child is expected to maser in each (Kathryn, 2010). Steinberger, (2005) reported that academic achievement encompasses student's ability and performance, it is multi-mentioned; it is intricately related to human growth and cognitive, emotional and social physical development; it reflects the whole child; it is not related to a single instance, but occurs across time and levels, through a student's life in public school and into post-secondary years and working life. Academic achievement refers to how well a student is accomplishing his tasks and studies.

Lyons, (2012) that it is an evidence in student's academic achievement depended upon the physical school facility, its age the design, and the condition of the school. Pandney (2008) defined academic achievement as the performance of the students in the subjects they study in school. This determines the student's status in the class. This gives children an opportunity to develop their talents, improve their grades and prepare for future academic challenges.

Academic achievement is therefore, a yard stick for ascertaining the capabilities of a student from which his overt, covert and inherent or unrevealed abilities could be inferred. Academic achievement is generally used toi determine how well an individual is able to assimilate, retain, recall,and communicate his knowledge of what has been learnt. It is knowledge attained or skills developed in school subjects usually designed by scores in formal tests or examinations. Academic achievement refers to the obtained and measured aspect of a student's mastery of skills and subject contents as measured with valid and reliable tests (Joe, Kpolovie, Osonwa & Iderina, 2014).

Academic achievement and interchangeably with academic performance, is indispensable in every educational institution. It pertains to scholarly human activities conducted in a formal educational environment. Academic achievement is a measurable index that depicts a student's cognitive, affective, and psychomotor domains in an educational setting. Student's academic achievement is ascertained by testing which has and will continue to play significant role in any educational system world-over.(Kpolovie, 2014a)

Students, teachers, parents and the society are much concerned about the academic achievement of students. Some of the purpose of academic achievement are itemized by Ekhasemohe (2010) as follows: to determine the relative effectiveness of the programme in terms of students behavior output, to identify students growth or lack of growth in acquiring desirable knowledge skills, attitudes and societal values, to help teachers determine the effectiveness of their teaching technique and learning materials, to help motivate students to learn more as they discover their progress or lack of progress in a given task, to encourage students to develop sense of discipline and systematic study habits, to acquaint parents or guardians with their children's performance, to predict the general trend in the development of the teaching-learning process, to make reliable decision about educational planning, to provide educational administrators with adequate information about teacher's effectiveness and school needs. Above all, academic achievement measurement is used for administration, guidance and counseling and research purposes.

2.4 Biology Laboratory Facilities and Students' Academic Achievement

Laboratory facilities are very necessary in knowledge construction, hence it is a contributing factor in the academic achievement of students in any senior secondary schools

in biology examinations in Nigeria. Umeh (2006) refers to facilities that can be used to enhance or improve educational programmes and promote teaching and learning. Science laboratory resources/facilities can be human or material. Although some facilities may be available and adequate but may not be put to use by the teachers. Umeh (2006) is of the view that audio visual aids such as computers and projectors are not utilized in schools due to lack of knowledge on the proper use of such facilities for teaching. Muhammad (2017) posted that facilities for the teaching of Biology exists in different forms and can be obtained in a number of ways. They may be real objects that exists freely within the environment or small plants and animals collected and preserved. They could also be illustrative diagrams, charts or models, purchased, produced or constructed. According to Adeogun (2010) discovered a very strong positive significant relationship between laboratory facilities adequacy and that of the academic performance. To others, schools endowed with more laboratory facilities or the resources always performed better than schools that are less endowed (Bello, 2012, Adesoji & Olatunbosun, 2008). Akpan (2006) indicate that learning can occur through the facilities that are adequate to students in the learning environment. Students can master better the basic concepts of Biology when they can learn by doing, so practical should function as the primary learning experience (Ifeakor, 2006).

Teaching can only be effective when adequate and relevant instructional laboratory facilities are used. But when instructional facilities and resources are lacking or are inadequate education is compromised and this will inevitably reflected in students low academic achievement (Falade, 2006). According to Oludare, Abiodun and Ajayi (2006) reported that there are no enough classrooms and laboratories, also laboratories have poor facilities and equipment and that supplies of chemicals and reagents for experiments are quiet low. Also that schools lack laboratory assistance resulting in the poor maintenance and obsolete nature of laboratory facilities (Imogie, 2010). Musah and Umar (2017) reported that physical laboratory facilities are the fundamental factors in better learning and achievements of the students. All facilities should be provided to the schools for the students better, concrete, and real experiences. For they said school facilities have been observed as a potent factor to quantitative education. The availability of laboratory facilities is essential for effective teaching and learning of science and consequently a good performance in students.

Mapaderun (2002) Adesina and Abraham, (2003) also emphasized that the availability and adequacy of these facilities of teaching facilitates learning process. laboratory

equipment, reagents, chemicals and laboratory space, promote effective teaching and learning activities in schools, while their inadequacy affects the academic performance negatively. Several efforts have been extended by teachers on improvisation techniques in various science subjects including biology, hence there is need to evaluate how far teacher have been able to improvise instructional facilities for effective teaching. Green (1989); Green in Utulu (2008) identified one of the problems of the Biology teacher during the teaching process as the provision of specimens in a laboratory class which can hamper or enhance the effective teaching of the subject. Consequently, it is not enough to establish laboratories, but also to equip them with appropriate facilities as much as possible to allow for individual student work or else it will be a situation of a tourist with a car but without money to buy petrol. This is an analogy of the effect of an ill-equipped laboratory on the performance of students who have good intentions to learn science. Kennedy (2009) also posted that there is inadequacy of laboratory facilities in secondary schools. He further said this inadequacy of teaching facilities/resources has been of serious concern to educators.

According to National Association of Biology Teachers (NABT, 2005) reported that Laboratory space. with Adequate and appropriate facilities, as well as equipment need to be provided for students to learn biology in a laboratory setting. This is essential at all levels of biology instruction, including elementary school, middle school, high school, college and university (Uch, 2010; Usen, 2016). A student-to instructor ratio in the biology laboratory must permit safe and effective instruction. Class size should be determined by the physical design of the classroom and should not exceed 24 students in a laboratory setting for any reason when students are assigned to a single teacher. Smaller limits should be set if students with special needs require more assistance from the teacher (Crescentia & Amos, 2011). Here, Adeogun (2010) reported that experiences in school settings where students interact with facilities and materials to observe and understand the natural world. Some laboratory activities have been designed and conducted to engage students individually, while others have sought to engage students in small groups and in large group demonstration settings. Teacher guidance and instructions have ranged from highly structured and teacher centered to open inquiry employing the use of available laboratory facilities.

Hofstein and lunetta (2003, 2005) that due to the extra time and preparation that laboratory courses require, life science teachers should not be assigned more than five classes per semester. Since each laboratory requires a different repertoire of organizations,

equipment, materials, supplies, solutions, and planning, and also demands lessons plans and grading time, teaching load should not be more than two process-oriented science course preparations and have no more than 24 students assigned to each class. Teachers should have their own science classrooms and have access to those classrooms during their preparation times. In high school, we strongly recommend that a laboratory manager (or instructional) aid be hired to assist in preparation, setup, and dismantling of laboratory facilities for experiential learning lessons (Crescentia & Amos, 2011, Eriba & Samba, 2011). Umeh (2012) said that Biology teachers agree that lack of skills/competencies required for facilities use, insufficient period for practical work, inadequate laboratory and instructional facilities, heavy teaching loads and large class size are the biggest factors hindering the utilization of facilities in teaching Biology. **Facilities:** The laboratory classroom should be equipped with work tables that have sinks, a water supply, and natural gas and electric outlets available. In sufficient quantity to support a laboratory- oriented biology course. Adequate ventilation, fume hoods, reference materials, and laboratory size must allow all students to participate in real hands-on activities. **Safety:** Approved guidelines for the safe use, maintenance storage and disposal of laboratory materials must be followed.

NABT (2005), Hofstein and lunetta (2003) These includes classroom instruction on safety and emergency procedures. NABT'S position statement on: The use of Animals in Biology Education or safety guidelines from organizations such as organization of scientific health agency occupational safety health agency (OSHA), national institutes of health national institute of health (NIH), the American chemical society, flinn Scientific, and appropriate safety procedures for using plants and micro organisms should be followed. Each laboratory room must be equipped with appropriate safety equipment, such as safety goggles and laboratory aprons for all students, a first –aid kit, a fire blanket, and an all purpose fire extinguisher. A safety shower and eyewash station should be available within a 20 – second walk if exposure to hazardous chemicals is a risk. Safety goggles, if used by different students, must be disinfected. Administrators must ensure adherence to applicable safety standards. Professional development for teacher in laboratory safety should be a high priority along with funding to provide appropriate safety equipment, ensure proper disposal of hazardous materials and provide sufficient space for students in the laboratory.

NABT (2005) continue to point out the most laboratory activities used in the schools are prepared commercially where NABT urges these other developers to provide instructional

activities that meet the above guidelines. The most productive curricula will be these with an abundance of active learning, such as laboratory investigations, upon which the teacher can base further indirect learning experiences, such as lectures, discussions and assignments. Adopted by the NABT BOARD OF DIRECTORS September 1990 and revised 2005.

Ajebade (2011); Hofstein and Naaman (2007) explain that developments in cognitive science and education corroborate the importance of empirical, heavily phenomenological experiences in learning of science skills as well as the concepts as a well equipped biology laboratory is known to have been contributing to high level academic achievement in students.

2.5 Adequacy of Biology Laboratory Facilities in Secondary School and Students' Academic Achievement

The aim of science laboratory and adequacy of laboratory facilities in secondary schools is for the running of an effective teaching/learning to take place, so that the expected outcome could be realized. The adequacy and the use of school laboratories have a strong relationship with academic achievement of students at secondary stage (Tobin , 1990). Eshiet (2006) added to the above contribution that laboratory facilities make science teaching more concrete and stimulating and hence for better students' academic performance in secondary schools.

Where these facilities are available the practical exercise should be more effective if the teachers are serious on the teaching process, which in the work of Igboabuchi (2010) said that biology laboratory facilities were seldom utilized by teachers or students during the teaching of biology hence facilities had significant influence on students academic performance. The availability of these facilities makes the work of the teachers to be easy and also makes the lessons to become concrete, simultaneous and continues to helps in enhancing the achievement of students in science, for instance in Lagos State secondary Schools had poor laboratory facilities; inadequate supply of chemical reagents (Oladare, Abiodun, & Bajulaiye, 2006). According to Ajayi (2008) also reported that Biology teachers in secondary schools have always lamented that among the various obstacles to effective teaching of Biology practicals things includes lack of laboratory space and equipment, large class and inadequate time allocation. According to Ekundayo (2009) contributed on the above issue that effective learning takes place in environment where learners are free to move around

without fear of collapse of building or being injured by broken down facilities. Inyang (2006) also reported that Biology laboratory requires animal rooms and green house for the preservation of special specimens or objects.

Krajeik, Mamlok and Hug (2001) reported that inquiry empowering technologies can assist students in gathering, organizing, visualizing, and interpreting data. Students can use probes to gather many data points rapidly. They can also use new technology tools to gather data across multiple trials and across longtime intervals (Friedler, Nachmias & Linn, 1990; Krajeik, Blumenfeld, Marx, & Soloway, 2000; Dori & Barak 2001); By using associated software they can examine graphs of relationships generated in real time as the investigation progresses, and examine the same data in spreadsheets and in other visual representations. When inquiry empowering technologies are properly used by teachers and students to gather and analyze data students have more time to observe, to reflect, and to construct conceptual knowledge that underlies the laboratory experiences. Furthermore, incorporate appropriate high technology facilities can enable students to conduct, interpret, and report more concepts, accurate, and interesting investigations. Such facilities can provide a medium for communication, for student- student collaboration, and for the development of a community of learners in the laboratory- classroom and beyond.

Pursuing that theme in Designing project-based science: connecting learners through guided inquiry Polman (1999) in The Laboratory in Science Education Foundations for the Twenty-First Century, also Krajeik, Mamlok and Hug (2001) contributed on modern context of science and technology on the enterprise of science to catch up with Twentieth century. Lunetta and Hofstein (2003) conducted an extended case study of a teacher who created a collaborative learning community and provided his high school students with opportunities to "learn by doing "authentic science in a science classroom. The teacher was guided by constructivist pedagogy giving special attention to collaborative visualization. Polman's analysis provides detailed information about the teacher's strategies and behaviors while implemented a project-based science model. Opara (2008). conducted a study and found that students who learned biology in small cooperative groups scored higher in achievement and on several inquiry skills than did students who learned in a large group class setting.

Mamalanga, Labeta and Madau (2014), based on a study conducted in Israel that a relationship exists between a student instructional pattern and characteristics (reasons for

learning) and his or her preference for certain instructional techniques in the science

classroom or laboratory Nwagbo, (2014); Onyegeghbu (2006). probed this relationship. Their study revealed a number of strong relationships between motivational traits and instructional preferences. They found that students they characterized as conscientious preferred more formal learning environments while others, more motivated by curiosity, enjoyed learning more open ended situations such as in inquiry laboratory activities (Kahraman & Sungur, 2011). Adesoji (2008); Akpan (2006); Umar (2006) stated that there are inadequate facilities for teaching and learning of science subjects in public secondary schools in Nigeria. They further stated that where there are little facilities at all, there are not in good condition; while the few ones that are in good condition are not enough to go round and also the few available facilities are dysfunctional.

NABT (2005) again contributed on the laboratory space should be available to the teacher during the planning and preparation period and available to students for special projects, makeup laboratories etc outside their regular class hours. Each student should have his/her own laboratory work space. There should be adequate space for storage of facilities and secure areas for storage of solvents, reactants, or potentially hazardous or dangerous chemicals as per guidelines set by the American chemicals society. Facilities should be inspected for structural and configuration updating every 10 years. There should also be a space dedicated to growing of living specimens for study in Biology class.

NABT, further reported that materials budgets, for that need to be implemented at all coursed, if curriculum designed is strictly observed for the goal of education. NABT position is on the implementation for supply of facilities by those in concern and the teachers role in implementing the facilities during teaching and learning of Biology.

Bello (2012); Lyons (2012). The national science Education standards address the need for making facilities available. Allocation of funds must provide opportunities to learn in an inquiry-based curriculum. To that end, Biology teachers must be provide with an annual budget sufficient to purchase both expendable facilities and equipment necessary to conduct inquiry-based learning. This is because Akpan (2006) strongly believed that shortages of laboratory facilities could have serious implications on the quality of schools output, Science Laboratory Facilities are very important resource input for teaching science and an important predictor of academic achievement.

2.6 Utilization of Biology Laboratory Facilities and Students'Academic Achievement

Eriba and Samba (2011) laboratory organization activities consist of the provision of necessary facilities, services, and equipment/materials. When these have been made available, then the act of management comes in to ensure that the materials so provide are catered for adequately for maximum efficiency. The manner in which the usage of laboratory is timed and shared out will determine to a great extent the profitability of utilization of the facilities to all concerned individuals and to the entire school as a whole. Further to this there should be adequate manpower in terms of trained science teachers, laboratory technologies, their assistants, and trained laboratory attendants who can organize and also they will ensure proper handling and usage during instructions as well as make sure that the end of the whole exercise the equipments are cleaned and stored properly (NABT, 2005).

According to Hofstein and Naaman (2007) the proper use of laboratory and demonstration of experiments are the indicators of students performance. Furthermore, science laboratories are provided to schools with the deficient quality and less quality of equipments, apparatus, and chemicals owing to limited funds. However, science laboratories may contribute to higher level of academic achievement if used effectively and properly with national commitment. Bello (2012) pointed out that availability and utilization of physics laboratory equipment has positive influence on the academic achievement of students, Poor state of performance as well as mass failure of physics in senior secondary schools is linked to the level of availability and utilization of the laboratory equipment in Nigerian secondary schools. The study conducted by him point it that science laboratory is a critical variable in determining the quality of output from secondary schools.

Muhammad (2017) pointed it clear that in the teaching and learning of Biology, the teacher and the learners are expected to adopt inquiry techniques (laboratory method). The emphasis is on learner experimentation and problem solving activities, the goal of which is to make learners autonomous individuals capable of coping with demands of life. This demands for practical activities at all stages of Biology teaching to enable students to acquire and master practical skills and experiences. This is in line with modern education thinking and practices which places great emphasis on the value of experience in the education process. If we truly value the development of knowledge, skills and attitudes that are unique to practical work in science laboratories, appropriate assessment of these outcomes must be developed and implemented continuously by teachers in their own laboratory- classrooms, (NRC, 1996).

The natural science education standard indicates that all the students learning experiences should be assessed and that the assessment should be authentic. Researchers, teachers, and testing jurisdictions whose goal is to assess comprehensively the learning that takes place in school science generally, or in school laboratories more specifically, should use appropriate assessment tools and methodologies to identify what the students are learning (conceptual as well as procedural). Lyons (2012) stated that learning is a complex activity that involves interplay of students' motivation, physical facilities, teaching resources, skills of teaching and curriculum demands.

According to Omosewo (2010) laboratory materials in the teaching/learning process facilitate the learning of abstract concepts and ideas, keep the learners busy and active thereby increasing their participation in the learning exercise. It also save the teachers' time and energy of talking too much, illustrate the concepts clearer and better than the teachers' verbal words only. These facilities also help overcome the limitations of the laboratory by making the inaccessible to become accessible, thereby broaden students' knowledge as well as increase their level of understanding as well as discourage rote learning. Uyoata (2006) also opined that meaningful learning requires the use of multisensory approach where appropriate instructional facilities are selected and utilized. He further said learning of science requires the use of multisensory approach, this is necessary because in this kind of learning students make use of more than one sense modality in learning.

Hofstein and Lunetta (2003, 2005). The school science laboratory continues to be perceived as a unique environment for teaching and learning science in a social setting that includes interactions with facilities and data, interactions between and among students, their teacher and sources of "expert" information. Nevertheless, as noted throughout the review, researchers have continued to observe that many science teachers do not utilize or manage this unique environment effectively. Also, Chukwuneka (2010) Neji, and Nuoha (2015) in their contribution on the utilization of biology laboratory facilities in secondary schools reported that teacher never utilized laboratory facilities during the teaching of Biology. Also according to Uyoata (2006) reported that a truckloads of items some of which are so strange and not related to the contents of the science curriculum are imposed on the teachers. Such materials or facilities are packed away where they collect dust for years which leads to malfunctioning of such facilities. they may lie waste because the teacher does not know how to use them. And when they are faulty the replacement parts are hardly available.

Teaching can only be effective when adequate and relevant instructional laboratory facilities are used (Falade, 2006). But when instructional facilities and resources are lacking or are inadequate education is compromised and this will inevitably is reflected in low academic achievement, and with high numbers of dropout rates, and this can led to poor teacher motivation and lastly unmet educational goals (Kohraman & Sungur, 2011, Ifeakor, Okoli & Nwafor, 2010).

Bullock, (2007). That many pre service and in-service courses in science and in science teaching and learning provide very limited direct experience, if any, through which the teachers can develop the skills needed to organize and facilitate meaningful, practical learning experiences for students in the school science laboratory (Udo, 2010). According to NABT (2005); Yung (2001) reported that teachers lack experience with methods enabling them to assess their students understanding and performance in the science laboratory. Thus, students' grades often do not reflect their performance in the laboratory work or their understanding of that work.

Abiona and Olagunju (2008) School environment has been described as an organization where resources are produced, manage and organized in such a way that enables the students to acquire desirable learning competencies. The process of managing and organizing resources is called resource utilization. The utilization of resources in teaching brings about fruitful learning science it stimulates students sense as well as motivating them.

Developing assertions about the natural world in school science and then justifying those assertions with data collected in investigations within or beyond the science classroom walls is considered increasingly to be an important element of school science learning. Examining and elaborating the nature of scientific argumentation in general, the utility of engaging students in these processes and the most appropriate ways to engage students in meaningful argumentation in the laboratory and school science are contemporary domains for research in science education that should have important implications for science teaching and curriculum (Hofstein & Lunetta, 2003).

Etuk, Koko, and Eno (2011). Often teachers do not perceive that laboratory activities can serve as a principal means of enabling students to construct meaningful knowledge of science, and they do not engage students in laboratories in ways that are likely to promote the development of science concepts. They may not perceive that they can manage laboratory

activities in ways that are consistent with contemporary professional standards, which in the work of Onipede (2004) Reported that many schools in Nigeria do not have laboratories with minimum standard facilities. A part from that, many teachers do not perceive that helping students understand how scientific knowledge is developed and used in a scientific community is an especially important goal of laboratory activities for their students.

Chukwuneka, (2010): Neji, and Nuoha (2015), reported that students are seldom given opportunities to use higher-level cognitive skills or to discuss substantive scientific knowledge associated with the investigation and many of the tasks presented to them continue to follow a "cook book" approach. Lunetta and Hofstein (3003, 2005) noted that interacting with instructional simulations can help students understand a real system, process, or phenomena. They suggested that within school settings, both practical activities and instructional simulations can enable students to confront and resolve problems, to make decisions, and to observe the effects. Whereas laboratory activities are designed to engage students directly with materials and phenomena, simulations can be designed to provide meaningful representation of inquiry experiences that are often not possible with real materials in many science topics. However, it is well established in general, that engaging students in appropriate simulations takes considerably less time than engaging them in equivalent laboratory activities with materials. They observe that some school administrators and teachers make decisions to use simulations with students instead of hands –on practical experiences (such as dissections) because the simulations are thought to be less troublesome or less expensive. Other teachers may elect to use simulations in lieu of dissections to avoid "wasting life" or they may let students and their parents decide on the basis of their religious or moral views. It is probable that the learning that will result from engaging in a well – conducted dissection or other practical experience will be quite different from the learning that will result from a good simulation (Hofstein & Naaman, 2007). Then Onyegegbu (2006) in his on contribution similar to simulation, that the use of Eletronic laboratory (E-Laboratory): E-Laboratory is a new computer programme that mimics laboratory experiences. These devices are special media of instruction which have both visual and aural appeal. The utilization of these new technological facilities or resources in science instructions makes learning of science concepts clearer to the students and also enable students to engage in critical thinking, problem solving and acquisition of new scientific knowledge and skills.

NABT, (2005): Polman (1999) reported that it is vital to provide opportunities that encourage learners to ask questions, suggest hypotheses and design investigations of minds –on as well as hands –on. They have noted, in general research has not provided evidence that such opportunities exist in most schools in the United States, or for that matter in other countries. Research has also suggested that while laboratory investigations offer important opportunities to connect science concepts and theories discussed in the classroom and in textbooks with observations of phenomena and systems, laboratory inquiry alone is not sufficient to enable students to construct the complex conceptual understandings of the contemporary scientific community. Again Akpan, (2006), suggested that meaningful learning is possible in the laboratory if the students are given opportunities to manipulate equipment and materials in an environment suitable for them to construct their knowledge of phenomena and related scientific concepts. Ihiegbulem (2006) added to the above point that resource materials utilization during practices lessons inculcates in the students the spirit of careful observation, manipulative, skills, respective thinking and creativity in the learners. School facilities have been observed as a potent factor to quantitative education. The adequacy and utilization of laboratory facilities are essential for effective teaching and learning of Biology and consequently a good performance in students (Ifeakor, 2006). According to Lassen, Steele and Sailor (2006), learning can occur through ones environment-facilities that are available to facilitate students learning outcomes. Students can master better the basic concepts of Biology when they can learn by doing. Appropriate facilities, equipment and adequate utilization of same are of necessity if school science courses to be successful. This implies that practical should function as the primary learning experience (Adesina,& Abraham, 2003).

2.7 Review of Related Empirical Studies.

The following are the reviewed empirical studies extracted on adequacy and Utilization of Biology Laboratory Facilities in senior secondary schools.

Adeogun (2010) conducted a study on the effects of instructional laboratory resources on students' performance in Biology in West Africa Senior School Certificate Examinations (WASSCE) in Nigeria. A correlation survey design was used, The researcher correlated material resources with academic achievements of students in biology using mean and standard deviation for research questions and Pearson Product Moment Correlation Coefficient for hypotheses. Data collected from the subject teachers 130 in relation to the

resources employed in the teaching. The achievements of students in WASSCE were related to the resources available for teaching the subject. The researcher concluded that material resources have a significant effect on students' achievement in Biology. The study relates to the present one because it sought to find out whether facility adequacy and utilization of Biology laboratory facilities affects students' achievement especially at NECO level. While the present study focus on WAEC and not NECO.

Musah and Umar (2017) in a study on effects of Availability and Utilization of Biology Laboratory Failities and Students' Academic Achievements in Secondary Schools in Yobe State, Nigeria. The study was conducted using a Correlational survey research design. A direct observation of secondary schools Biology laboratory inventory and what is available in the schools science laboratory was carried out during the study using a questionnaire checklist and proforma. The target population of all senior secondary two (SS2) students studying Biology and 42 Heads of departments of Biology in the public secondary schools in Yobe State. A total of 370 SS2 Biology students drawn from the senior secondary schools across the three educational zones in Yobe State. The data generated in the study was analyzed using descriptive statistic for research questions and hypotheses were subjected to multiple correlation. It was find that Biology laboratory facilities in Yobe State secondary schools are not available enough to be used by the students. This situation subsequently affects the performance of the students. They further reported that there was a strong positive correlation between the variables that is Biology laboratory facilities and student academic achievement. It was recommended that Biology laboratory should be equipped with functional facilities to improve students academic achievement in Biology. The study is similar to the present one in terms of utilization of Biology laboratory facilities, but the universe is very far distance apart with Taraba State. And the population of the study is not the same with the present study.

Crescentia, Sekegor and Agadaigho, (2013) conducted a study on availability and utilization of biology laboratory facilities in secondary schools to aid learning in Ethiope-West local government Area of Delta state Nigeria. The study was carried out because of need to enhance the teaching and learning of biology in our secondary schools. A descriptive survey of ex-post facto design was adopted for the study. The population of the study was all SS2 students and teachers in the fourteen public secondary schools in Ethiope-west local government area of Delta state. A sample of 56 students and seven teachers were used for the

study using the systematic sampling technique. A self-prepared checklist extracted from the West African Examination Council Regulations and syllabus for West African senior school Certificate Examinations was used for the study. The data were analyzed using Chi-square-goodness-of-fit-test and pearson-product-moment correlation in testing the null hypotheses. Results revealed that there were imbalances in biology laboratory facilities in the local government area since only one school had the facilities and materials, acquisition of laboratory skills depends on student's participation and teacher's qualification is an asset for proper utilization of the laboratory. It was recommended that the government, parents, teachers and all concerned bodies make effort to provide secondary schools with laboratory facilities, materials (specimens) and equipment. The study is related to this study as it tried to find out how Biology laboratory facilities influence students' performance at WASSCE level in only one local government, while the present study is on more than one local government area.

Adeyemi (2008) conducted out a study, titled science laboratories and the quality of output from secondary schools. The study examined science laboratories and the quality of output from secondary schools in Ondo State, Nigeria. The design was made along the lines of a descriptive survey while the study population comprised of all the 257 secondary schools that presented candidates for the year 2003 senior secondary Certificate Examinations in the State. The sample consisted of 168 secondary schools drawn randomly from the study population. The instrument used to collects data for the study was an "inventory" while the data collected was analyzed using the one-way analysis of variance (ANOVA). Semi-structured interviews 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 schools having laboratories in three science subjects, Physics, Chemistry and Biology. Mean scores were highest in schools having three science laboratories. The interviewee responses agreed with the findings of the study. On the basis of the findings, it was recommended that Government should urgently provide laboratories in the three science subjects in schools with shortages of science laboratories. The study therefore, is related to this study because biology is inclusive in the study and the study tried to ascertain the students' performance in WASSCE as carried by the above researcher. The present study is focused attention only to Biology (science).

Arshad and Ahmad (2011) conducted out a study which was to identify the effect of the availability and the use of science laboratories on academic achievement of students in Punjab ,Pakistan. Science laboratories and the use of science laboratories in the public schools in Pakistan as variables. Population of the study comprised all secondary and higher secondary schools, secondary teachers and secondary students in Punjab. Overall, a total of 288 schools, then 20 students and 10 teachers from each school were randomly selected as the sample of the study. School profile proforma, a questionnaire for teachers and Result sheet were the instruments of the study. Pearson correlation was used to find out the relationship [association] and stepwise Regression analysis with linear function were used to find out the differential impact [causal-relationship].it was revealed that there is a great deficiency in the availability and the use of science laboratories. The study concluded that the less availability misallocation and the deficiency in the use of science laboratory items lead to the wastage of resources, the less effectiveness of science laboratory and lower academic achievement. The policy implications of the study are that science laboratory can have an enormous effect if science laboratory items are properly allocated, equalized per student and efficiently used with the standard quantity and quality. The study relates with this study in terms of Biology laboratory facilities utilization which influence students' achievements, but the study is outside the country (Nigeria) unlike the present one that is carried out in Nigeria.

Ifeakor, Okoli and Nwafor (2010) conducted a study on: an appraisal of the availability and utilization of new technological resources for science curriculum delivery in Nigerian Universities. The study was a descriptive survey design, which was carried out in both federal and state universities in South-East states of Nigeria. the population of the study comprised all basic science lecturers in the nine universities in South-East states. The sample consisted of 78 lecturers from federal universities and 62 lecturers from state universities. Stratified random sampling technique due to location was used to select two federal and two state-owned universities out of four federal and five state universities. Thus 140 lecturers were participated in the study. Three research questions and three null hypotheses guide the study. The instrument for data collection was a 36-item questionnaire structured on a 4-point modified Likert-type scale developed by the researchers. The research questions were answered using mean and standard deviation, while the null hypotheses were tested at 0.05 level of significance using t-test. The result of the study showed that most of the new technological facilities were not available in the federal and state universities. The new facilities among others are over-head projectors, digital video disc, television, radio world

wide web facilities and computer software programmes that were not sufficiently available in the universities. Recommendation among others is that in-service training programme should be organized for serving teachers through sponsoring them to workshops, seminars and conferences. The study is related to the present study about utilization of learning facilities in schools, even though the present study is on secondary schools while that of the above one is on tertiary institutions, and was carried out by more than one person.

Adodo and Oyeniyi (2013) carried out study on Student Variables as Correlates of Secondary School Students' Academic Performance in Biology in Nigeria. The design of the study was descriptive survey research type. The target population for the study were SS3 Biology students of senior secondary schools classes in Ikere Local Government Area of Ekiti State, Nigeria. Four hundred and five Biology students (male/female) were randomly selected from ten secondary schools from Ikere Local Government Area of Ekiti State, formed the sample. The researchers used the following instruments to elicit the relevant data. Questionnaire on gender/attitude and Biology Achievement Test (BAT). The result revealed that correlation matrix of students variables and students' academic performance in Biology, shows that there is significant relationship between student variables and students' academic performance in Biology of secondary schools in Ikere Local Government Area of Ekiti State. It was recommended that students should have the mind that Biology is fascinating and should view it as something around them every day, and not as an abstract subject. Also, students of Biology must cultivate good study habit and good interest in the subject. The above study is related to the present one in terms of secondary schools academic performance in Biology subject. However, the present study is on adequacy and utilization of Biology laboratory facilities, and not on the students variables to correlates to their academic performance or achievement, and also did not use Biology achievement test but checklist, then also on more than one local government area.

Abiona and Olagunju (2008) conducted a study in Nigeria on production and Utilization of Resources in Biology Education. A case study of south west Nigerian secondary schools, in the study; a survey of 450 teachers from 150 randomly selected secondary schools in Oyo, Ogun, Osun, and Ondo State were used. Two instruments were prepared, validation and used for collecting data. Percentages and t-test statistics were used in data analysis. Three research questions and two hypotheses were addressed and tested. The findings revealed (1)less than average number of teachers produce material resources (2) few

teachers use microscope magnifying glasses, preserved specimens, models, quadrat and aquarium (3) male teachers perception of utilization of resources is significantly higher than their female counterparts. Recommendations among six listed, Biology teachers should select the cheapest available equipment for demonstration or illustration of principles and concepts in science teaching. The functionality and durability of equipment should be taken into consideration. The study relates to this study on the ground of utilization of Biology resources. However, the present study covered only part of one State as against four States carried out by the above researchers.

Osarenren-Osagbe and Irabor (2012) in a study on availability and adequacy of human and material resources for the teaching and learning of skill based courses in Nigerian public schools using descriptive survey. In doing that, three research questions were raised and two hypotheses were formulated. The population of the study was consist of academic staff and final year students of 2009/2010 academic session in Nigeria public tertiary institutions. The instruments used to collect data were the questionnaire and checklist. The researcher personally visited the ten institutions that were used for study through stratified random sampling and administered the questionnaires to the respondents who numbered1750 but only 1500 were returned. Data was analyzed using the mean statistics, percentage and t-test. The finding amongst others was that the human and material resources on ground for the teaching and learning of skill based courses in Nigerian public Universities did not match the minimum standard requirement recommended by the National Universities Commission. Based on these findings, recommendations such as government, non-governmental organization and good citizen should provide the needed human and material resources to help in the production of skilled graduates for national development were made amongst others, and hopefully when response to that, learning process will yield positive results. The study is also similar to this very one in terms of the correlating facilities adequacy and as well as the students' academic achievement, though it was carried out at tertiary institution and not secondary schools, like the present study. And the above study uses percentages/t-test in analysis while the present study used regression analysis.

Muhammad (2017) in a study titled a survey of Availability, Utilization, and Maintenance of Biology Laboratory Equipment and Facilities in Secondary Schools in Sokoto State, Nigeria a descriptive design was adopted for the study. Where four research questions were used without hypotheses in the study. Five senior schools were selected from

each of the six zonal education offices in the state, using stratified sampling technique. A total of 30 senior secondary schools with 30 Biology teachers one from each of the schools were sampled for the study. An observation schedule with a checklist of 30 items was used in collecting data for the study. The researcher visited each of the schools twice. On the first visit, the available laboratories and the facilities in them were observed, on the second visit the Biology teachers were observed while teaching. Data collected were analyzed using descriptive statistics. It was find that laboratories are available in secondary schools in Sokoto State. Out of the 30 laboratories observed only 11 have some facilities in them that is 36.66%, the remaining 19 63.33% laboratories have no facilities in them of the 11 items available only 7 23.33% are in good condition that they could be used in the teaching of Biology. Based on the findings of the study, it was concluded that Biology laboratories in Sokoto State have inadequate facilities, that the few available ones are not optimally utilized and a lot of them are laying waste due to lack of care. It was recommended that all science laboratories should be well equipped with relevant, and modern facilities for effective teaching and learning of Biology. The study covers even the maintenance apart from availability and utilization of Biology laboratory facilities and was also covered the whole state, while the present study have nothing to do with maintenance and also concentrated on Taraba north geopolitical zone.

Ajaja (2009) in the study investigated the production and utilization of materials resources in Biology education in South West Nigerian Secondary Schools. 450 teachers from 150 randomly selected secondary schools in Oyo, Ogun, Osun, Lagos and Ondo States were used in the study. Two instruments were prepared, validated and were used for data collection. Chi-square, percentage and t-test statistics were used for data analysis. Three research questions and two hypotheses were addressed and tested respectively. Results revealed that less than the average number of teachers produce material resources, and only few teachers use microscope, magnifying glasses, preserved specimens, models, quadrat and aquarium. Recommendations were made for supply of facilities for effective teaching and learning process. The above study is related to the present one as concerning the utilization of facilities, but covered five states, which is more than a state/part of state like that of the present study that covered only one part (geopolitical zone) of the state.

Okoro (2015) conducted a study on the availability, adequacy and utilization of instructional materials/equipment in Biology instruction in the Senior Secondary Schools in

Owerri Zone. The sample comprised twenty Biology teachers and forty Biology students, all from twenty Secondary Schools that offered Biology in Owerri Zone and were selected using cluster random sampling. The instruments used were checklist and questionnaire, which were validated by a team of educationists of Abia State University, Uturu. The data were analyzed using frequency counts and percentages with 50% as the basis for pass and failure. Results indicated that the schools have on the average 59.0%. Most of the available items were not adequate for instructions. The result further indicated that the students were not always expected to the use of the available instructional materials during instructions. It was recommended among others that the school administrators should ensure that their teachers administer both theory and practical work during instructions using available instructional materials and improvisation be made with the help of the students where some of the materials which could be made locally are not available. The study is related to this study in terms of biology laboratory facilities their utilization could led to improvement of students' academic programme. However, the study applied to zone at the southern part of Nigeria, while the present study is at the northern part of the country.

Andy and Sofeme (2012) conducted a study on relationship between learning resources and students academic achievement in science subjects in Taraba state secondary schools in Nigeria. A total of 35 science teachers and 18 science head of departments from six schools from three geopolitical zones of Taraba state were involved in the study. Ex-post facto was used as research design. Three different research instruments were employed in collecting the data:(1) bio-data of science teachers for Biology, chemistry and physics (2) laboratory equipment inventory checklist (L E I C) for biology (B L E I C); chemistry (C L E I C) and physics (P L E I C) for the 18 science laboratories of the schools selected. (3) Student's Academic Achievement scores collected from students' scores in WASSCE from 2003-2007. Four null hypotheses were formulated and tested using Pearson's product moment collection method and Students t-test statistic. The results of data analysis revealed that laboratory equipment and the number of qualified teachers were inadequate for biology, chemistry and physics where there were no qualified teachers at all. The result also revealed that availability of qualified science teachers had no significant relationship on academic achievement of students in science subjects at p less than 0.05.The results also indicated that there was no significant difference in the academic made of schools with adequate laboratory equipment and those without them. The results also showed that there was no significant difference in the academic achievement of students in science subjects of students who

attended pure science schools and those who attended non-pure science schools. From the findings, it was recommended that more learning resources be provided in the secondary schools in Taraba state. The study is related to this study of the same universe, but the above study covers the whole state, while the present one covered only part of the state.

Bello (2012) carried out study on effect of Availability and Utilization of Physics Laboratory Equipment on Students' Academic Achievement in Senior Secondary School Physics in Nigeria. The study employ descriptive survey design. Three research questions were raised in the study. Forty-five senior secondary schools with 24 public schools, 14 private, and 7 federal/unity schools were randomly selected from the south western region of Nigeria. The study sample physics teachers and SS2 physics students randomly chosen from each school, making the total of 50 physics teachers and 900 SS2 physics students. Three instruments were used in the study, physics laboratory equipment questionnaire (PLEQ), physics laboratory equipment checklist (PLEC) and physics achievement test (PAT). The data collected was analyzed using percentages and Chi-Square. The result indicate that there is significant relationship between the utilization of physics laboratory equipment and students' academic achievements in physics. The result further revealed and concluded that science laboratory is a critical variable in determining the quality of output from secondary schools. The findings also showed that science laboratory had significant relationship with quality of output from secondary schools. It was recommended among others that inspections should be routinely carried out on schools laboratories and worn out equipment been replaced with new ones. The study is similar to the very one ongoing, with different of subject and subject laboratory facilities all together.

Madulia (2012) carried out a study on Relationship between the availability of teaching/learning resources and performance in Secondary school Science subjects Biology in Kenya. The study examined the relationship between availability of both human and non-human resources for teaching/learning and performance in the Science subjects in the Kenya Certificate of Secondary Education (KCSE) examination. The study was carried out at Eldoret Municipality, Kenya. Stratified random sampling was used to draw the sample of 14 head of teachers, 56 teachers and 308 Form Three students, based on the schools performance in KCSE science subjects for the period 2001-2005, from 7 low performing schools and 7 high performing schools. The purpose of the study was to establish if availability and utilization of teaching and learning resources are among factors that influence performance in

science subjects in Eldoret Municipality. Data collected by using three questionnaires administered to the head teachers, teachers and students. A descriptive statistics were used to analyze and summarize the data. T-test was used to ascertain the significant differences between means of low performing and high performing schools. Correlation was used to show relationships between performance and the research variables. From the findings, it reveals availability of textbooks, revision books, laboratory chemicals and equipment was higher in the high performing schools than in the low performing schools. Findings also showed that 2 in 7 low performing schools did not have a laboratory. All the 5 low performing schools that had a laboratory lacked laboratory facilities and technician's in one of them was fully equipped. Moreover, none of the low performing schools had a library, and all the high performing schools had more than one laboratory. As such, creates differences in availability of teaching/learning resources between the high performing schools and low performing schools. Therefore, Ministry of Education should initiate more training programmers' on provision, improvisation and utilization of teaching/learning resources. The study has practical implications for learners, teachers, school administrators, parents and educational officials in relation to provision and use of teaching/learning resources. As recommendation, there is need for awareness of all factors that affect performance and means of alleviating poor performance. In addition, when ranking schools' performance, factors such as schools' endowment with both human and non-human resources need to be considered. The study relates to this study in terms of adequacy of Biology laboratory as well as external examinations like WASSCE/KCSE. However, the present study is in Nigeria, while the above study is outside the country.

Okafor (2014), investigated relationships between Utilization of Laboratory Facilities and Academic Performance of Students in Biology in Senior Secondary Schools in Zamfara State, Nigeria. A total of 63 schools were sampled from the four Educational Zones of the state. Three hundred and seventy five students and 155 teachers were selected using stratified sampling technique. The research instruments were Biology Laboratory Facility Checklist (BLFCL) for teachers and students utilization of Biology laboratory facilities (SUBLF). The student's utilization of Biology laboratory facilities has reliability coefficient of 0.71 which was used. Correlation survey design was used. Three null hypotheses were tested. Spearman's Rank order and t-test statistics were used to determine relationship and differences at $p< 0.05$. The major findings from the study are; thereis no adequate functional biology laboratory facility in the senior secondary schools in Zamfara State. Also, there is

significant relationship in the mean scores of utilization of biology laboratories facilities and students' performance in Biology in senior secondary schools in Zamfara State. There was no significant difference in the availability of Biology laboratory facilities in female and male public schools. There was no significant difference in the supply of biology laboratory facilities to private and public schools. Recommendations made are; that the Inspectorate division of Ministry of education and head of biology department to conduct a regular inspections to the public schools to see that the facilities are used for the purpose for which they are meant. The state government should address the problem of large class syndrome that hindered the students from using the facilities for improving their academic performance. The study is related to this study in terms of comparing students' performance with the adequacy of Biology laboratory facilities in senior secondary schools in Nigeria, though the study was carried out in another state in Nigeria and no proforma was used for data collection, while the present one is at Taraba State where profporma and checklist were used.

Neji, Hope, John and Obi (2014) conducted a study with title Evaluating the adequacy of laboratory facilities and students achievement in secondary schools in Nigeria, the study seeks to relate the extent of adequacy of laboratory facilities and students' academic performance in Calabar using Survey design. A total of 35o copies of questionnaire were administered to Biology students in order to assess the facilities impact on the students' academic performance. Results obtained showed that laboratory facilities in secondary schools are not adequate enough for teaching Biology. The result was also affirmed in the tested hypothesis which showed that adequacy of facilities does not significantly contributed to the variance in students' academic performance in Biology. The present study is related about adequacy of Biology laboratory facilities. However, the present study use checklist and not questionnaire for data collection.

Thomas (2013) on the effect of teacher preparation on students academic achievements in SS2 Biology practicals in Jalingo, Taraba State, Nigeria. The study adopted the descriptive survey design, and sample of 2060 and 50 students and teachers respectively using stratified sampling. Result revealed that students' academic performance is significantly based on teachers preparation pathways and how teachers managed biology laboratory learning facilities to teach Biology in Jalingo, Taraba State. Recommendations among others that Biology teachers' should be motivated more efficiently for them to give in their best in the job, because if they do well the students' will be properly taught as they

ought to and our society will feel the positive effect of quality teaching. The study is related to the present study in terms of universe, students academic achievement in Biology. While the present study use larger sample than the above study covering six local governments.

Ihejiamaizu, and Ochui, (2016) study on utilization of biology laboratory equipment and students' academic performance in Cross River State, Nigeria. The research area was Northern Education Zone of Cross River State. Ex-post facto research design was used for the study. The sample consisted of 490 SS3 biology students of the 2015/2016 academic session. Sample selection was stratified sampling technique as was based on local government areas was first used. Simple random sampling technique of balloting method was used to select 14 schools in the zone. The method was again used to select 35 students each from the 14 sampled schools, giving a total of 490 SS 3 Biology students who participated in the study. Instrument used was Utilization of Biology Laboratory Equipment Checklist (UBLEC) and Biology Achievement Test (BAT) with 30 items. Data collected were analyzed using one-way analysis of variance (ANOVA). Findings indicated that there is a significant influence of utilization of Biology laboratory equipment on students' academic performance. Recommendations among others supervisors and inspectors from the Ministry of Education should strictly monitor the frequency use of laboratory equipment by both teachers and students. This will ensure a hitch free utilization of the available science laboratory equipment in teaching and learning of Biology and such process will encourage students to do science of Biology instead of learning about it. The above study is related to the present one the ground of checklist as a tool for data collection, utilization of Biology laboratory facilities and students academic achievement. The present study did not use ANOVA for analysis but regression.

2.8 Summary of Literature Reviewed and Uniqueness of the Study

This study is related to many other learning theories, however; System Theory was the one chosen for its applicability. The theory observed some opportunities given to learners to use laboratory facilities as input to their own means of learning process and its output towards attainment of their set goals in the learning environment.

The empirical studies that were reviewed to guide this study, some of them were from other countries and also many from Nigeria.

A study conducted by Okoro on the availability, adequacy and utilization of instructional materials/equipment in Biology instruction in the Senior Secondary Schools in Owerri Zone. Results indicated that the schools have on the average 59.0%. Most of the available items were not adequate for instructions. The result further indicated that the students were not always exposed to the use of the available instructional facilities during instructions.

Adeogun conducted a study on the effects of instructional laboratory resources on students' performance in Biology in West Africa Senior School Certificate Examinations (WASSCE). The achievements of students in WASSCE were related to the resources available for teaching the subject. The research concluded was that facilities or material resources have a significant effect on students' achievement in Biology.

Another study was that of Agadaigho and Sekegor to find out the availability and utilization of biology laboratory facilities to Aid learning in Ethiope- West local government area of Delta state Nigeria. The study showed that there were imbalance biology laboratory facilities in the local government area since only one school had the facilities or materials. Okafor (2014) investigated on the utilization of laboratory facilities and academic performance of students in biology in senior secondary schools in Zamfara State, Nigeria. The major findings from the study are; there is no adequate functional biology laboratory facility in the senior secondary schools in Zamfara State. Also, that there is significant relationship in the mean scores of utilization of biology laboratories facilities and students' performance in Biology in senior secondary schools in Zamfara State.

However, limited studies have been carried out on the relationship among Adequacy, Utilization of biology laboratory facilities and students' academic achievement in senior secondary schools in Taraba State. Most of the studies conducted were across Nigeria and the world at large Madulia, (2012).carried out a study on Relationship between the availability of teaching resources and performance in Secondary School Science subjects (Biology) in the Kenya Certificate of Secondary Education (KCSE) examination. Another study in Nigeria, was conducted by Abiona and Olagunju (2008) on Production and Utilization of Resources in Biology Education. A case study of south-west Nigerian Secondary Schools. The study covers more than a state, with larger sample than this study. This study therefore, is aimed at filling the gaps by investigating the level of adequacy and utilization of Biology laboratory

facilities and students' academic achievement in senior secondary schools in Taraba state, hence the uniqueness of this study.

CHAPTER THREE

METHODOLOGY

This chapter contains the description of the methods that were used in carrying out the study under the following subheading: research design, area of study, population, sample and sampling techniques, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection, and method of data analysis.

3.1 Design of the Study

This study adopted the correlational survey design. The correlational survey design was adopted, because it describes the relationship between two or more naturally occurring variables. Not only that; some factors are impossible to manipulate experimentally. Relationship between variables do not imply that variables share something in common as in this case participant opinion (Jennifer, 2013).This deals with relationship that exists between the populations with two or more variables (Adeyemi, 2008). According to Aloysius (2011) very often researchers are interested in examining the extent of relationship that exists between two variables. The extent of relationship is approached through the distributions of scores that represent the two variables. The extent of relationship between two scores is referred to as correlation coefficient. In other words, correlation is the degree of relationship which exists between two sets of scores.

3.2 Area of the Study

The study was conducted in Taraba State. The geographical location of Taraba state lies roughly between latitude 6’ 30 and 9’ 36 North and longitude 9’ 10; 50 East. The state capital is Jalingo (Taraba State Government Diary 2010). Taraba state is bounded by Bauchi and Gombe states in the North-East and Adamawa on the East by Plateau state on the North-West. The state is further bounded to the west by both Nasarawa and Benue States, while it shares an international boundary with the Republic of Cameroon to the south and south-west. Taraba state has a total land mass Area of 60291.82 square Kilometers. Taraba state has 16 local government areas with 156 senior secondary schools. The state is divided into six educational zones. Taraba State Northern zone with 62 schools (comprise of Jalingo education zone, Karimlamido educational zone and Zing educational zone respectively). Then central zone with 39 schools (with two education zones) and southern zone with 55

schools (with two education zones as well). (Taraba State Teaching Service Board, Zonal Monitory Offices, 2016).\

3.3 Population of the Study

The population of the study was 4635 SS3 students studying Biology from Taraba North Geopolitical Zone in senior secondary schools in Taraba State. And only SS3 were chosen for the study because it is their WAEC results that were used. Another reason for using SS3 students is based on the fact that they had chosen their subjects combination for career. It was easy to use 247 SS3 students of mixed sex with average age ranging from 14-20 mainly of Mumuye and Hausa tribe, from six schools visited for the study.

3.4 Sample and Sampling Technique

The sample for the study was 247 SS3 students that studying Biology was used. 48 Biology teachers was selected using balloting of picking yes or no, from each Schools and 6 examination officers from Taraba-North Geopolitical Zones of three Educational Zones of the state which comprise of Jalingo, Karimlamido and Zing Education Zones. The zone has more (6) local government areas than Taraba –Central and Taraba-South Geopolitical Zones with 5 local government each. Therefore, all the six Local Government areas were used in this study. The six schools from the zone that were used, one from each of the Local Government Areas using balloting of picking yes or no was employed from each Schools. Purposive sampling technique was used to select schools that have Biology single purpose laboratory in Taraba State senior secondary schools. Purposive sampling was chosen because some schools have multi-purpose laboratories, while others do not have Biology laboratory at all. And also Andy and Sofeme (2012) use the same technique in choosing laboratories.

3.5 Instrument for Data Collection

Two instruments were used for data collection, the Biology Laboratory Equipment Inventory Checklist (BLEIC) and Proforma for collecting students WAEC Biology result. Where direct observation of schools Biology laboratory inventory was carried out by the researcher of this study for data collection on what schools hard in their laboratories as facilities for studying Biology. The instruments for data collection were Biology Laboratory Equipment Inventory Checklist (BLEIC). The checklist consisted of 50 items meant to give information on the adequacy and utilization of biology laboratory facilities with codes and

grading system of: Not Adequate (NA-1), Slightly Adequate (SA-2), Moderately Adequate (MA-3), Adequate (A-4), Highly Adequate (HA-5). Then under the utilization codes/grading are: Not Utilized (NU-1), Slightly Utilized (SU-2), Moderately Utilized (MU-3), Utilized (U-4), Highly Utilized (HU-5). Then proforma was used, to collect students academic achievement, which consisted of nine grades system as: distinction (A1, B2, B3), credit (C4, C5, C6), pass (D7, E8) and fall (F9), as in accordance with WAEC recommendation for senior secondary schools; to measured students academic achievement in Biology. The researcher of this study and Biology teachers as research assistance filled in the instruments under adequacy and utilization while examination officers as another research assistance extracted Biology WAEC results into the proforma sheet appendix section pg 76. Based on the Likert scale, Nworgu (1990) suggested that the 'undecided' point should mark the beginning of the scale and be interpreted as an absolute zero since it corresponds to a complete absence of opinion in the particular circumstance. When responding to a Likert scale on questionnaire item, respondents specify their level of agreement or disagreement on a symmetric agree-dis-agree scale for a series of statements. These response options are weighted with numerical values, which can be summed up and the total score obtained to determine that person's position on the variable being measured.(Wuensch, 2005; Geoff,2010). In this case, 5 point scale was used for this study.

3.6 Validation of the Instrument

The BLEIC items were adopted from the single subject (Biology) Science Laboratory Environment Inventory Checklist of WAEC syllabus 2013.This is because Agadaigho and Sekegor (2013), Andy and Sofeme (2012) used the same instrument for science laboratory. To ensure content validity the BLEIC and Proforma were subjected to content and face validity by two experts from Department of Environmental and Life Sciences Education from Modibbo Adama University of Technology Yola. The validators checked the appropriateness of the items on the checklist to ensure that the items covered the biology laboratory facilities and also met the minimum requirements as stipulated by WAEC. Their comments and corrections were utilized to draft the final instrument (See Appendix section page 83).

3.7 Reliability of the Instrument

The instrument (checklist) on adequacy, and utilization of laboratory facilities were trial tested on 30 students of SS3 studying Biology in three schools from Taraba-Central

Geopolitical Zones which were outside the schools used for the study. Students responded to the items under utilization and adequacy, while their examination officer responded to the Proforma. The schools used for trial testing had similar educational background with those used for the study. Split-half (odd and even numbers) reliability method was used to calculate the reliability coefficient. The data collected were correlated using. Split half statistic was used to compute reliability coefficients of 0.72 and 0.74. This reliability coefficient is half reliability coefficient and with it a full reliability coefficient of 0.86 was computed using Spearman Brown Formula (See Appendix p 78 for the computation).

3.8 Procedure for Data Collection

The data for the study were generated through the use of checklist of BLEIC with 50 items on adequacy and utilization of Biology laboratory facilities. The researcher of this study filled the checklist with 48 Biology teachers as research assistance of the various schools in order to obtain the level of adequacy and utilization of Biology laboratory facilities. Where direct Biology laboratory facilities were observed by both the researcher and the various research assistants on every school as was moving round the laboratories, at the same time were filling in the checklist. The WAEC results from 2009-2013 were collected as well for students' academic achievements using the proforma by the researcher together with the examination officers of schools used for the study as research assistance.

3.9 Method of Data Analysis

The data collected from the study were analyzed using statistical package for social sciences (SPSS). The research questions were answered using descriptive statistics of mean and standard deviation and real limits of numbers while, the hypotheses were tested using linear regression analysis and multiple regression analysis. Linear regression analysis were used to test hypotheses 1and 2, while multiple regression analysis was used to test hypothesis three. Linear and multiple regression analyses were carried out to determine whether adequacy and utilization of Biology laboratory facilities correlate students' academic achievement in senior secondary schools. The decision rule for research questions will be as follows on appendix section page 82.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents data analysis, results and discussion of the findings. The data collected for the study were analyzed using descriptive statistics, linear and multiple regression analysis. The presentation is done in order of the research questions and hypotheses.

4.1Results

Real limit of numbers was used to take decision on research questions.

4.1.1 Research Question 1: What is the level of adequacy of biology laboratory facilities and students' academic achievement in senior secondary schools in Taraba State?

To answer this question, the data on adequacy generated via Checklist were subjected to statistic mean and standard deviation computed and used to draw

Table 1.Mean and Standard Deviation of the Level of Adequacy of Biology Laboratory Facilities in Senior secondary Schools in Taraba State?

s/n	Facilities	Mean	S. D	Remarks
1.	Agar	2.57	0.86	MA
2.	benedict solution	2.78	1.38	MA
3.	common salt	2.05	1.06	SA
4.	vegetable oil	2.58	0.76	MA
5.	starch powder	2.57	0.86	MA
6.	Milk	2.93	1.29	MA
7.	Yeast	2.05	1.06	SA
8.	reducing sugar	2.58	0.76	MA
9.	Formaldehyde	2.95	1.34	MA
10.	bunsen burner	2.57	0.86	SA
11.	Basins	2.58	0.76	MA
12.	dissecting boards	2.47	1.01	SA
13.	dissecting kits	2.68	0.67	MA
14.	tripod stand	1.73	0.60	SA
15.	cotton wool	2.05	1.06	SA
16.	fire extinguisher	2.57	0.86	MA
17.	Microscope	2.03	0.85	SA
18.	petri dishes	2.57	0.86	MA
19.	ph meter	2.58	0.76	MA
20	Quadrand	2.57	0.86	MA
21	Scissors	2.15	1.08	SA
22	sharp knives	1.83	0.72	SA
23	Sieves	2.57	0.86	MA
24	Buckets	1.96	0.78	SA
25	trowels/spaces	2.68	0.67	MA
26	Spatulas	2.57	0.86	MA
27	test tube and racks	2.68	0.67	MA
28	test tube holder	2.15	1.08	SA
29	wash bottles	2.57	0.86	MA
30	absorbent paper	2.57	0.86	MA
31	soil test box	2.57	0.86	MA
32	computer and software	2.57	0.86	MA
33	fridge/freezers	2.57	0.86	MA
34	overhead projector	1.53	0.77	SA
35	graduated cylinder	2.19	0.69	SA
36	hand lens	2.29	0.92	SA
37	medical spacemen	2.09	0.93	SA
38	Bottles	2.03	1.02	SA
39	microscope slides	1.63	0.73	SA
40	Thermometer	2.55	1.01	MA
41	Funnels	2.55	1.01	MA
42	wash bottles	2.10	1.13	SA
43	Beakers	2.55	1.01	MA
44	conical flasks	2.68	0.67	MA
45	cover slips	2.57	0.86	MA
46	Droppers	2.68	0.67	MA
47	Skeletons	1.96	0.90	SA
48	wall charts/poster	1.72	0.91	SA
49	shelves/beaches	1.62	0.85	SA
50	chairs/stools	2.57	0.86	MA
	Grand Mean	2.36	0.88	SA

Key: Standard deviation =S.D; Moderately Adequate = MA; Slightly Adequate = SA

Table 1 shows that out of 50 biology laboratory facilities as stipulated by WAEC, items 1, 2, 4, 5, 6, 8, 9, 11, 13, 16, 18, 19, 20, 23, 25, 26, 27, 29, 30, 31, 32, 33, 40, 41, 43, 44, 45, 46 and 50 were moderately adequate and slightly adequate in items 3, 7, 10, 12, 14, 15, 17, 21, 22, 24, 28, 34, 35, 36, 37, 38, 39, 42, 47, 48 and 49. With a grand mean of 2.36, shows that Biology laboratory facilities in Taraba State senior secondary schools were slightly adequate.

4.1.2 Research Question 2: What is the level of utilization of Biology laboratory facilities and students academic achievement in senior secondary schools in Taraba State?

To answer this question, the data on utilization generated via Checklist instrument were subjected to statistic mean and standard deviation computed and used to draw

Table 2.Mean and Standard Deviation of the Level of Utilization of Biology Laboratory Facilities in Senior Secondary Schools in Taraba State?

s/n	Named of Facilities	Mean	S. D	Remarks
1.	Agar	2.02	0.94	SU
2.	benedict solution	2.36	1.22	SU
3.	common salt	3.23	1.45	MU
4.	vegetable oil	2.22	1.14	SU
5.	starch powder	2.41	1.04	SU
6.	Milk	2.10	1.13	SU
7.	Yeast	2.19	1.14	SU
8.	reducing sugar	2.27	1.12	SU
9.	Formaldehyde	2.05	1.06	SU
10.	bunsen burner	2.20	1.21	SU
11.	Basins	2.78	1.38	MU
12.	dissecting boards	2.15	1.08	SU
13.	dissecting kits	2.34	1.08	SU
14.	tripod stand	2.27	1.10	SU
15.	cotton wool	2.93	1.29	MU
16.	fire extinguisher	2.22	0.97	SU
17.	Microscope	2.34	1.00	SU
18.	petri dishes	2.95	1.34	MU
19.	ph meter	2.28	1.21	SU
20	Quadrand	2.33	1.16	SU
21	Scissors	2.47	1.01	SU
22	sharp knives	2.30	0.78	SU
23	Sieves	2.16	0.86	SU
24	Buckets	2.19	1.09	SU
25	trowels/spaces	2.04	0.95	SU
26	Spatulas	2.33	0.89	SU
27	test tube and racks	2.55	1.01	MU
28	test tube holder	2.57	0.86	MU
29	wash bottles	2.76	0.90	MU
30	absorbent paper	1.96	0.90	SU
31	soil test box	1.73	0.91	SU
32	computer and software	1.61	0.86	SU
33	fridge/freezers	1.68	0.85	SU
34	overhead projector	1.76	0.91	SU
35	graduated cylinder	2.24	0.71	SU
36	hand lens	2.17	0.74	SU
37	medical spacemen	2.26	0.98	SU
38	Bottles	2.26	1.10	SU
39	microscope slides	2.20	0.99	SU
40	Thermometer	2.22	0.74	SU
41	Funnels	2.58	0.76	MU
42	wash bottles	2.53	0.86	MU
43	Beakers	2.68	0.67	MU
44	conical flasks	2.51	0.77	MU
45	cover slips	1.88	0.72	SU
46	Droppers	2.38	0.87	SU
47	Skeletons	2.12	0.75	SU
48	wall charts/poster	2.22	0.83	SU
49	shelves/beaches	1.84	0.77	SU
50	chairs/stools	2.01	0.77	SU
Grand	Mean	2.27	0.97	SU

Key: Standard deviation = S.D; Moderately Utilize = MU; Slightly Utilize = SU

Table 2 shows that out of 50 Biology laboratory facilities as stipulated by WAEC, items 3, 11, 15,18, 27, 28, 29, 41, 42, 43 and 44 were moderately utilize and slightly utilize in items 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14,16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31 , 32, 33, 34, 35, 36, 37, 38, 39, 40, 45, 46, 47, 48, 49 and 50. With a grand mean of 2.27,

shows that biology laboratory facilities in Taraba State senior secondary schools were slightly utilized.

4.1.4 Hypotheses Testing

The hypotheses were tested using linear and multiple regression analysis.

H_{O1}: Adequacy of Biology laboratory facilities does not significantly correlate with senior secondary schools students' academic achievement in Taraba State.

Table 4a: Linear Regression Table of Adequacy of Laboratory Facilities and Students Achievement in Biology

Model		Sum of Squares	Df	Mean Square	F	p-value	Remark
1	Regression	335.88	1	335.887	485.26	0.000[b]	Reject
	Residual	170.27	246	0.692			
	Total	506.16	247				

a. Dependent Variable: Achievement

b. Predictors: (Constant), Level of Adequacy

Table 4b:Model Summary of Linear Regression Table of Adequacy of Laboratory Facilities and Students Achievement

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.815[a]	0.664	0.662	0.83

a. Predictors: (Constant), Level of Adequacy

b. Dependent Variable: Achievement

Tables 4a-b show that there is a significant difference between the various R values, $F = 485.26$ ($df = 1$), $p < 0.05$. Since the computed p-value (0.00) is less than 0.05 level of significant, therefore the null hypothesis of no significance is rejected. This means that adequacy of laboratory facilities correlates with students' academic achievement in Taraba State. Furthermore, the coefficient of correlation is 0.815, it indicated that the correlation is very high to students' academic achievement. The result showed that there was a significant positive relationship between adequacy of laboratory facilities and biology students' academic achievement in Taraba State ($r = 0.81$; $p < 0.05$).

H_{O2}: Utilization of Biology laboratory facilities does not significantly correlate with senior secondary schools students' academic achievement in Taraba State.

Table 5a: Linear Regression Table of Utilization of Laboratory Facilities and Students Achievement **in Biology**

Model		Sum of Squares	Df	Mean Square	F	p-value.	Remark
1	Regression	280.944	1	280.944	306.86	0.000[b]	Reject
	Residual	225.217	246	0.916			
	Total	506.161	247				

a. Dependent Variable: Achievement
b. Predictors: (Constant), Level of Utilization

Table 5b:Model Summary of Linear Regression Table of Utilization of Laboratory Facilities and Students Achievement in Biology

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.745[a]	0.555	0.553	0.95

a. Predictors: (Constant), Utilization of Laboratory Facilities
b. Dependent Variable: Achievement

Tables 5a-b show that there is significant difference between the various R values, F = 306.86 (df = 1), P < 0.05. Since the computed p-value (0.000) is less than 0.05 level of significant, therefore the null hypothesis is rejected. This means that utilization of laboratory facilities correlates with students' academic achievement in Taraba state. Furthermore, the coefficient of correlation is 0.745, it indicated that the correlation is high to students' academic achievement, as a result of utilization of Biology laboratory facilities. The result also show that there was a significant positive relat ionship between utilization of Biology laboratory facilities and students' academic achievement in Taraba State (r = 0.745; p < 0.05).

H_{O3}: Adequacy and utilization of Biology laboratory facilities do not significantly correlate with senior secondary schools students' academic achievement in Taraba State.

Table 6a : Multiple Regression Table of Adequacy and Utilization of Laboratory Facilities and Students Achievement in Biology

Model		Sum of Squares	Df	Mean Square	F	p-value	Remark
1	Regression	336.49	2	168.247	242.95	0.000[b]	Reject
	Residual	169.66	245	0.693			
	Total	506.16	247				

a. Dependent Variable: Achievement

b. Predictors: (Constant), Level of Adequacy and Level of Utilization,

Table 6b: Model Summary of Multiple Regression Table of Adequacy and Utilization of Laboratory Facilities and Students Achievement in Biology

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.815[a]	0.665	0.662	0.83

a. Predictors: (Constant), Level of Adequacy and Level of Utilization

b. Dependent Variable: Achievement

Tables 6a-b show that there is significant difference between the various R values, F = 242.95 (df = 2), P < 0.05. Since the computed p-value (0.000) is less than 0.05 level of significant, therefore the null hypothesis is not rejected. Therefore, adequacy and utilization of laboratory facilities have significantly combine effect on students' academic achievement. Furthermore the coefficient of correlation is 0.815. this indicate that there is very high correlation among adequacy, utilization and students' academic achievement. This is as a result of adequacy and utilization of Biology laboratory facilities.

The result also shows that there was a significant relationship among adequacy, utilization of laboratory facilities and biology students' academic achievement in Taraba State (r = 0.82; p < 0.05).

4.2 Major Findings of the Study

The findings of the study are as follows

1. Biology laboratory facilities in senior secondary schools in Taraba State were slightly adequate in relation to WAEC minimum requirement with a grand mean of 2.36.
2. Biology laboratory facilities in senior secondary schools in Taraba State were slightly utilize with a grand mean of 2.27
3. Adequacy of laboratory facilities significantly correlate Biology student's academic achievement, $F = 485.26$ ($df = 247$); $r = 0.815$; $P < 0.05$.
4. Utilization of biology laboratory facilities significantly correlate Biology student's academic achievement, $F = 306.86$ ($df = 247$);$r = 0.745$; $P < 0.05$.
5. Adequacy and utilization of laboratory facilities significantly correlate with Biology student's academic achievement, $F = 242.95$ ($df = 247$); $r = 0.815$; $P < 0.05$.

4.3 Discussion

This study found out that biology laboratory facilities in senior secondary schools in Taraba State were slightly adequate with mean 2.36, standard deviation 0.88. This finding concurred with Lyons (2012), Agadaigho and Sekegor (2013), Aminu and Bah (2017) who found out that there is few, inbalance and inadequate biology laboratory facilities. This inadequacy of laboratory facilities greatly affects the total comprehension of students and may lead to poor academic achievement. This result supported Mohammed (2017)who discovered that school laboratories are filled with inadequate, obsolete and damaged facilities. This result also agrees with Onipede (2004) who reported that many schools in Nigeria do not have laboratories with minimum standard facilities. Similarly, this finding corroborate with Onipede (2004), Ihuarulam (2008), Arshad and Ahmad (2011), Sofeme and Andy (2012) who in their separate studies reported that science education is faced with the problem of lack of resources with half of senior secondary schools having no real laboratory talk less of fully equipped ones. Akpan (2006) and Okoro(2015) strongly believed that shortage of laboratory facilities may have serious implications on the quality of school product.

Adequacy of laboratory facilities significantly predicts biology student's academic achievement, This result disagree with Neji, Hope, John and Obi (2014) who reveal that adequacy of facilities does not significantly contributed to the students' academic performance in Biology. However, this finding agrees with Adeyemi (2008), Sofeme and Andy (2012) who indicated that there was statistical relationship between laboratory facilities adequacy and students' academic achievement. Also Arshad and Ahmad (2011) revealed that there is a great deficiency in the availability

and the use of science laboratories which lead to poor academic achievement of students in secondary schools. Madulia (2012) found out that there is linear and positive relationship between adequacy laboratory facilities and students' academic achievement.

The level of biology laboratory facilities in senior secondary schools in Taraba State were slightly utilized with mean 2.27, standard deviation 0.97.This finding concurred with Okoro (2015) and Aminu and Bah (2017) and who found out that biology laboratory facilities are not fully utilized in senior secondary schools in Nigeria which may affect their psychomotor skill and academic achievement. Neji and Nuoha (2015) also found out that laboratory facilities are not adequately utilized in secondary schools for teaching Chemistry. Abiona and Olagunju (2008) and Ajaja (2009) revealed that few teachers use microscope magnifying glasses, preserved specimens, models, quadrat and aquarium This result also agree with Lyons (2012) who stated that learning is a complex activity that engage interplay of learners motivation, physical facilities, teaching resources, skills of teaching and curriculum demand.

Utilization of biology laboratory facilities significantly predict biology student's academic achievement, This finding disagrees with Neji and Nuoha (2015) found out that utilization laboratory facilities do not significantly contribute to the variance in students' academic performance in Chemistry. Simililarly, Etiuben (2010) revealed that utilization of Chemistry laboratory facilities has no significant influence on students' academic performance. Also, the present research finding has debunked that of Ihejiamaizu, and Ochui (2016) whose finding showed no significant correlation between utilization of science laboratory facilities and students' academic performance in chemistry. However, this result concurs with Abiona and Olagunju (2008), Okoro (2015) revealed that there is significant relationship between teachers' use of laboratory facilities and students' performance. Also, Opara (2008) revealed that the 26.4% of the laboratory facilities were utilized during Chemistry teaching and learning while 74% showed that laboratory facilities were never utilized during Chemistry teaching. The finding also revealed that laboratory facilities had a significant influence on the students' academic performance. Chukwuneka (2010) revealed that utilization of laboratory facilities/equipment in secondary schools showed that 26% of the teachers never utilized laboratory facilities. The findings of Chukwuneka also revealed that laboratory facilities significantly influenced students' academic performance in science. Also Igboabuchi (2010) found out that Biology laboratory facilities were seldom utilized by both teachers and students during Biology teaching. The

results also revealed that the use of Biology laboratory facilities had a significant relationship with the students' academic performance in Biology.

Similarly, Okafor (2014) revealed that there is significant relationship in the mean scores of utilization of biology laboratories facilities and students' performance in Biology in senior secondary schools. In the same vein Thomas (2013) revealed that students' academic performance is significantly based on teachers preparation pathways and how teachers managed and utilize biology laboratory learning facilities to teach Biology. Also Ihejiamaizu, and Ochui, (2016)Findings indicated that there is a significant influence of utilization of Biology laboratory equipment on students' academic performance. This may be as a result of teacher utilization of available laboratory facilities during laboratory session and may enhance psychomotor skills of the students. This implies that utilization of laboratory facilities may improve students' academic achievement.

Adequacy and utilization of laboratory facilities significantly predicts biology student's academic achievement, This finding agree with Adesoji and Olatunbosun (2008); Okeke (2010) and Aminu and Bah (2017) who revealed that adequacy of laboratory facilities and utilization were found to enhance student academic achievement through manipulation and use of facilities in the laboratory. Similarly Adeogun (2010) found out that adequacy and utilization of material resources and laboratory equippment have a significant effect on students' achievement in Biology. Mohammed (2017) Findings revealed that most senior secondary schools have no laboratories. Where they exist, they are poorly equipped and slightly utilized. This shows that teachers indicated reluctance and inability in conducting practical works using the few available laboratory facilities. This finding supported Ajayi (2008) which reported that school laboratories have inadequate infrastructure, most of the equipment are broken down and are too old for modern science teaching and learning. This implies that the age of the equipment spare parts are no longer available, therefore is very difficult to utilize it and may have effect on students' academic achievement. Bello (2012) found out that there is strong positive significant relationship between adequacy and utilization laboratory equipment and academic performance. Therefore, laboratory adequacy and utilization of facilities affects the performance of students. This is true as students tend to use, manipulate, understand and recall what they see more than what they hear only and this may enhance their academic achievement.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the Study

The study was aimed at determining whether the relationship among adequacy, utilization of biology laboratory facilities and students academic achievement will correlate with students' academic achievement in senior secondary schools in Taraba State. Three research questions and three hypotheses were formulated and tested at 0.05 level of significance. Nineteen empirical studies were reviewed to guide the study. The theoretical framework employed in this study was system theory propounded in 1940 by Ludwig Von Bertalanffy. The study employed correlation research design using Biology Laboratory equipment inventory checklist (BLEIC) and Biology students' porforma. The population of the study was 4635 Biology (SS 3) students in senior secondary schools in Taraba state. The sample of the study was Biology (SS 3) students in senior secondary schools drawn purposively to participated in the study. A checklist of Biology Laboratory equipment inventory and Biology SS3 students, Biology teachers and examination officers were used for the collection of data. The data collected in the study were analysed using mean and standard deviation, regression analysis and multiple regression analysis.

The findings of the study were that Biology laboratory facilities in senior secondary schools in Taraba State were slightly adequate with mean 2.36, standard deviation 0.88 and slightly utilize with mean 2.27, standard deviation 0.97. The study also found that there was a significant positive prediction between adequacy of laboratory facilities and students' academic achievement in Biology. The finding shows that there was a significant relationship and positive correlation between utilization of laboratory facilities and students'academic ach ievement in Biology. The study also revealed that there was a significant relationship and strong correlation among adequacy, utilization of laboratory facilities and students' academic achievement in Biology.

5.2 Conclusion

Based on the findings of the study it was concluded that Biology laboratory facilities were slightly adequate and also slightly utilized in senior secondary schools in Taraba State. There was a significant relationship and positive correlation among adequacy, utilization of laboratory facilities and students' academic achievement in Biology. This implies that when

there is adequate Biology laboratory facilities in schools may have tremendous implications on the quality of school product. In the same vein if Biology laboratory facilities in schools are fully utilize will enhance psychomotor skills in teaching and learning Biology. Therefore making Biology more concrete, interesting, real and student academic achievement may increase.

5.3 Recommendations

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

1. Biology teachers should be encouraged to practically teach Biology through the use of the few available facilities in their schools to enhance understanding.
2. Biology laboratory should be well equipped with relevant and modern facilities for effective teaching and learning to meet up with 21st century demands.
3. Government and all stake holders in education should assist in ensuring that adequate facilities for teaching and learning Biology are provided in the secondary. It is evident that availability of Biology laboratory facilities promote learning of the subjects.

5.4 Suggestions for Further Studies

Based on the results of this study the following suggestions for further studies are

1. There is need for further research on Biology teacher laboratory facilities innovation skills on students' academic achievement in Nigeria.
2. There is need for further research on Biology teacher laboratory requisitions kills on students' academic achievement in Nigeria.
3. Similar study should be carried out in another part of the country to enable generalization of the findings.
4. The study was limited to relationship among adequacy, utilization of Biology laboratory facilities and academic achievement of senior secondary schools students in Taraba State, Nigeria.
5. There is a significantly positive relationship among adequacy, utilization of biology laboratory facilities and student's academic achievement, $F = 242.95$ (df 2, 247), $P < 0.05$.

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Appendix I: Request for Validation of Instrument

School of Technology and Life Science and Environmental, Modibbo Adama University of Technology, Yola

Adamawa State.

18/10/2016.

Sir/Madam,

REQUEST FOR VALIDATION OF INSTRUMENT

I wish to apply for the above mentioned subject matter. I am with ID NO. M.TECH/SCE/15/1053. (Biology Education student) in the above named institution carrying out a research on the topic: "Level of Adequacy and Utilization of Biology laboratory facilities on students' academic achievement in senior secondary schools in Taraba State."

The attached instrument is part of the study. Please do the face/content validation of the instrument as your input and comments will be strictly used for the purpose of this study only

Thanks for your usual co-operation.

Yours' faithfully

Boyi, K. J

M.TECH/SCE/15/1053

Name of Instrument: Biology Laboratory Equipment Inventory Checklist (BLEIC).

Name of school:……

Introduction Under the adequacy and utilization of biology laboratory facilities in senior secondary schools, the following items was used to measure student's opinion/attitude.

Instruction; On each item, select one option and tick appropriately. The researcher and the biology teachers fill in the items of the checklist under adequacy and Proforma, while utilization of biology laboratory facilities in senior secondary schools can be filled by students.

Every item was then have two ticks one option selected under Adequacy and one under Utilization as contained in the B L E I C checklist.

Here, are options and their codes as Key: Very Adequate (VA=5), Adequate (A=4), Moderately Adequate (MA=3), Fairly Adequate (FA=2), Not Adequate (NA=1). And under the utilization key: Very Utilized (VU=5), Utilized (U=4), Moderately Utilized (MU=3), Fairly Utilized (FU=2), Not Utilized (NU=1).

			ADEQUACY.					**UTILIZATION.**				
S/No	Name of Facilities/items.	Benchmark	VA5	A4	MA3	FA2	NA1	VU5	U4	MU3	FU2	NU1
1.	Agar	41-42										
2.	Benedict solution	40-60										
3.	Common salt	40-50										
4.	Vegetable oil	25-30										
5.	Starch powder	30-35										
6.	Milk	10-20										
7.	Yeast	5-10										
8.	Reducing sugar	30-50										
9.	Formaldehyde	15-20										
10.	Bunsen burner	50-70										
11.	Basins	30-40										
12.	Dissecting boards	50-70										
13.	Dissecting kits	30-40										
14.	Tripod stand	60-70										
15.	Cotton wool	5-10										
16.	Fire Extinguisher	5-10										
17.	Microscope(monocular/binocular).	4-6										
18.	Petri Dishes	50-60										
19.	PH Meters	10-15										
20	Quadrates	25-35										
21	Scissors	10-15										
22	Sharp Knives	25-35										

23	Sieves	20-30										
24	Buckets	2-5										
25	Trowels/spaces	10-20										
26	Spatulas	60-80										
27	Test tube and its Rack	60-80										
28	Test tube holders	60-80										
29	Wash bottles	50-70										
30	Absorbent paper	20-25										
31	Soil test box	4-7										
32	Computer and software	10-15										
33	Fridge/freezers	10-15										
34	Overhead projectors	5-6										
35	Graduated Cylinder	30-40										
36	Hand lens	50-60										
37	Medical Specimens	10-20										
38	Bottles	40-60										
39	Microscope Slides	50-60										
40	Thermometer	40-60										
41	Funnels	20-30										
42	Wash bottles	30-40										
43	Beakers	40-60										
44	Conical Flasks	40-60										
45	Cover Slips	70-90										
46	Droppers	60-80										
47	Skeleton	3-5										
48	Wall Charts/Posters	20-40										
49	Shelves/Beaches	4-8										
50	Chairs/Stools	60-80										

PROFORMA

Under the following grades as distinction, credit, pass and fail in senior secondary schools West African Examination Council (WAEC), those grades/scores will be used to measure students academic achievement in biology from 2009-2013.

Here, are the grades or scores with their codes as key: Distinction (A1), Distinction (B2), Distinction (B3), Credit (C4), Credit (C5), Credit (C6), Pass (D7), Pass (E8) Fail (F9).

School ……

	DISTINCTION			**CREDIT**			**PASS**		**FAIL**
YEAR	A1	B2	B3	C4	C5	C6	D7	E8	F9
2009									
2010									
2011									
2012									
2013									

Table 1: WAEC Results in Biology for Taraba State students for five Years 2009-2013.

Year.	Grades A1, C6 ,	D7, E8, F9.	Total Registered.
2009	145	573	1014	1732
2010	258	263	267	788
2011	45	716	140	901
2012	283	882	201	1366
2013	647	442	151	1240

Source: Taraba State, Ministry of Education Department of Education Resource Centre, Jalingo (2016).

RELIABILITY /VARIABLES=item1 item2 item3 item4 item5 item6 item7 item8 item9 item10 item11 item12 item13 item14 item15 item16 item17 item18 it em19 item20 item21 item22 item23 item24 item25 item26 item27 item28 item29 item30 item31 item32 item33 item34 item35 item36 item37 item38 item39 item40 item41 item42 item43 item44 item45 item46 item47 item48 item49 item50 /SCALE('ALL VARIABLES') ALL /MODEL=SPLIT /STATISTICS=DESCRIPTIVE SCALE /SUMMARY=TOTAL MEANS VARIANCE COV CORR.

Reliability

[DataSet1]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	3	75.0
	Excluded[a]	1	25.0
	Total	4	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Part 1	Value	.866[a]
		N of Items	14[b]
	Part 2	Value	.874[a]
		N of Items	9[c]
		Total N of Items	23
		Correlation Between Forms	.500
Spearman-Brown Coefficient		Equal Length	.867
		Unequal Length	.867
		Guttman Split-Half Coefficient	.867

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

b. The items are: Agar , Benedict solution, Common salt, Vegetable oil, Starch powder, Milk, Yeast, Reducing sugar, Formaldehyde, Bunsen burner, Basins, Dissecting boards, Dissecting kits, Tripod stand

c. The items are: Cotton wool, Fire Extinguisher, Microscope(monocular/binocular)., Petri Dishes, PH Meters, Quadrates, Scissors, Sharp Knives, Sieves.

Item Statistics			
	Mean	Std. Deviation	N
Agar	2.3333	.57735	3
Benedict solution	3.3333	.57735	3
Common salt	1.6667	1.15470	3
Vegetable oil	2.0000	1.00000	3
Starch powder	1.6667	.57735	3
Bunsen burner	2.3333	.57735	3
Basins	2.3333	1.52753	3
Tripod stand	2.0000	1.00000	3
Cotton wool	2.0000	1.00000	3
Fire Extinguisher	1.3333	.57735	3
Microscope(monocular/binocular).	1.6667	.57735	3
Scissors	1.3333	.57735	3
Sharp Knives	2.3333	.57735	3
Sieves	2.3333	.57735	3
Microscope Slides	1.6667	.57735	3
Thermometer	1.6667	.57735	3
Wash bottles	1.3333	.57735	3
Beakers	2.0000	1.00000	3
Conical Flasks	2.0000	1.73205	3
Cover Slips	1.6667	.57735	3
Droppers	2.0000	1.00000	3
Shelves/Beaches	2.0000	1.00000	3
Chairs/Stools	2.0000	1.00000	3

Summary Item Statistics								
		Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	Part 1	2.048	1.333	3.333	2.000	2.500	.271	14[a]
	Part 2	1.815	1.333	2.000	.667	1.500	.059	9[b]
	Both Parts	1.957	1.333	3.333	2.000	2.500	.195	23
Item Variances	Part 1	.690	.333	2.333	2.000	7.000	.350	14[a]
	Part 2	.926	.333	3.000	2.667	9.000	.716	9[b]

	Both Parts	.783	.333	3.000	2.667	9.000	.481	23
Inter-Item Covariances	Part 1	-.018	-1.500	1.667	3.167	-1.111	.353	14[a]
	Part 2	-.028	-1.500	1.500	3.000	-1.000	.666	9[b]
	Both Parts	.002	-1.500	2.500	4.000	-1.667	.482	23
Inter-Item Correlations	Part 1	-.009	-1.000	1.000	2.000	-1.000	.685	14[a]
	Part 2	-.104	-1.000	1.000	2.000	-1.000	.862	9[b]
	Both Parts	-.031	-1.000	1.000	2.000	-1.000	.735	23

a. The items are: Agar , Benedict solution, Common salt, Vegetable oil, Starch powder, Milk, Yeast, Reducing sugar, Formaldehyde, Bunsen burner, Basins, Dissecting boards, Dissecting kits, Tripod stand.

b. The items are: Cotton wool, Fire Extinguisher, Microscope(monocular/binocular)., Petri Dishes, PH Meters, Quadrates, Scissors, Sharp Knives, Sieves.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Agar	42.6667	14.333	.991	.	.244
Benedict solution	41.6667	21.333	-.500	.	.180
Common salt	43.3333	10.333	.988	.	.642
Vegetable oil	43.0000	27.000	-.866	.	.388
Starch powder	43.3333	24.333	-.995	.	.287
Bunsen burner	42.6667	21.333	-.500	.	.180
Basins	42.6667	9.333	.786	.	.711
Tripod stand	43.0000	13.000	.693	.	.322
Cotton wool	43.0000	13.000	.693	.	.322
Fire Extinguisher	43.6667	14.333	.991	.	-.244
Microscope(monocular/binocular).	43.3333	24.333	-.995	.	.287
Scissors	43.6667	21.333	-.500	.	.180
Sharp Knives	42.6667	21.333	-.500	.	.180
Sieves	42.6667	21.333	-.500	.	.180
Microscope Slides	43.3333	24.333	-.995	.	.287

Thermometer	43.3333	24.333	-.995	.	.287
Wash bottles	43.6667	14.333	.991	.	.244
Beakers	43.0000	13.000	.693	.	.322
Conical Flasks	43.0000	7.000	.982	.	1.197
Cover Slips	43.3333	24.333	-.995	.	.287
Droppers	43.0000	27.000	-.866	.	.388
Shelves/Beaches	43.0000	13.000	.693	.	.322
Chairs/Stools	43.0000	13.000	.693	.	.322

Scale Statistics

	Mean	Variance	Std. Deviation	N of Items
Part 1	28.6667	6.333	2.51661	14[a]
Part 2	16.3333	6.333	2.51661	9[b]
Both Parts	45.0000	19.000	4.35890	23

a. The items are: Agar , Benedict solution, Common salt, Vegetable oil, Starch powder, Milk, Yeast, Reducing sugar, Formaldehyde, Bunsen burner, Basins, Dissecting boards, Dissecting kits, Tripod stand.

b. The items are: Cotton wool, Fire Extinguisher, Microscope(monocular/binocular)., Petri Dishes, PH Meters, Quadrates, Scissors, Sharp Knives, Sieves.

Level of Adequacy	**Real Limits of Numbers**	**Remark**
Highly Adequate	**4.5 – 5.00**	**HA**
Adequate	**3.5 – 4.49**	**A**
Moderately Adequate	**2.5 – 3.49**	**MA**
Slightly Adequate	**1.5 – 2.49**	**SA**
Not Adequate	**0.5 – 1.49**	**NA**

Level of Utilization	Real Limits of Numbers	Remark
Highly Utilized	**4.5 – 5.00**	**HU**
Utilized	**3.5 – 4.49**	**U**
Moderately Utilized	**2.5 – 3.49**	**MU**
Slightly Utilized	**1.5 – 2.49**	**SU**
Not Utilized	**0.5 – 1.49**	**NU**

The decision rule on testing the null hypothesis will reject the null hypothesis when $p<0.05$ and if $p>0.05$ do not reject the null hypothesis.