

Adequacy and Effective Utilization of Laboratory Equipment as Predictors of Secondary School Students' Learning Outcome in Edo North Senatorial District, Nigeria

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Abstract

This study examined the adequacy and effective utilization of laboratory equipment as predictors of secondary school students learning outcome in Edo North Senatorial District, Nigeria. Three research questions guided the study while one hypothesis was tested at 0.05 level of significance. The study was anchored on theory of constructivism developed by Piaget (1937). The study adopted the correlational research design. The population of this study comprised 26, 371 senior secondary school students in all the public secondary schools in Edo North Senatorial District, Nigeria. One thousand three hundred and twenty (1,320) senior secondary school students representing 5% of the entire population of students was drawn from the District. The simple random sampling technique was used to draw the 5% of the students. The data for this study were collected using two instruments namely: Adequacy and Utilization of Laboratory Equipment Checklist (AUTLEC) and Students' Academic Performance Inventory (SAPI). The academic performance was based on WASCE result for 2017/2018 school year in Chemistry, Physics and Biology. The data obtained were analyzed with Percentages and Multiple Linear Regression Analysis (MLRA). The study revealed that the level of adequacy of laboratory equipment was very low, the level of utilization of laboratory equipment was very low and the availability and utilization of laboratory equipment predicted secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria. Based on the findings, the study recommended among others that the government and other stakeholders of the education industry should collaborate to equip public schools with all the necessary and required laboratory equipment to boost students' interest in science based subjects and to improve on their learning outcome.

Keywords: Adequacy, Effective Utilization, Laboratory, Equipment, Predictors, Students Learning Outcome

Introduction

The key to the development of any nation lies in the cultivation of talents and practical virtues of its citizens. The awakened mind, right knowledge, sophisticated skills and desirable attitudes are the indicators of national development. In this regards, education helps in unfolding the latent powers or talents of the individuals for personal growth and national development. It also helps in increasing and equipping students with the latest knowledge of science and technology which are germane for national growth and development. In Nigeria and in other nations of the world, education system is described as the bedrock of development. It is so because of the effective roles it plays in the political, social and socio-economic development of nations and the relevance it got in the global space. According to United Nations Educational Scientific and Cultural Organisation (UNESCO), nations of the world have given attention and invested much resources in the education sector especially in science while others do not. According to the report, spending on science worldwide increased (+19%) between 2014 and 2018, as did the number of scientists (+13.7%). This trend has been further boosted by the COVID crisis, according to UNESCO's new Science Report, *The Race against Time for Smarter Development*. It stated further that these figures hide significant disparities: just two countries, the United States and China, account for nearly two-thirds of this increase (63%) while four out of five countries lag far behind, investing less than 1% of their GDP in scientific research. The scientific landscape thus remains largely a landscape of power. (<https://en.unesco.org/news/unesco-report-calls-substantial-increases-investment-science-face-growing-crises>). It means that countries of the world needs to invest more in science education because the full-flowering of talents and virtues by a suitable programme of education surely contributes to the pace of progress of a nation (Bawa, nd).

Therefore, the education system is described as a means to harnessing talents and virtues for achieving development of a nation in all its facets as well as developing human resources capable of contributing to the development of the nation's economy. The Federal Government of Nigeria (2013) stated that the human being is a positive asset and a valuable national resource which need to be cherished, nurtured and developed. This development of sound human resource is important for the development of a nation. Bawa (nd) emphasized that development of individual includes certain qualities development of self-confidence, generation of scientific temper, attainment of self-sufficiency, sense of devotion to duty, discipline and decency, sense of dedication, promotion of social and ethical values, fostering a positive attitude towards unity and integrity of nation, and cultivation of social efficiency. For this development of human resources to be achieved, the government must focus much attention on the Nigerian education system especially the secondary schools.

The Federal Government of Nigeria (2013) stated that the goals of the Nigerian secondary school education shall be to provide all primary school leavers with the opportunity for higher level, irrespective of sex, social status, religious or ethnic background; to offer diversified curriculum to cater for the differences in talents, opportunities and future roles; to provide trained manpower in the applied science technology and commerce al sub-professional grades; to develop and promote Nigerian languages, arts and culture in the context of world's cultural heritage; to inspire students with a desire for self-improvement and achievement of excellence; to foster national unity with an emphasis on the common ties that unite us in our diversity; to raise a generation of people who can think for themselves, respect the views and feeling of others, respect the dignity of labour, appreciate those values specified under our national goals and live as good citizens and to provide technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development. To achieve these aims and objectives, most especially those that focused on science and technology, adequate and functional laboratory tools must be provided in schools to enhance effective teaching and learning of science subjects such as Chemistry, Physics, Agricultural Science and Biology. According to Mokoro (2020), laboratory facilities play a significant role in determining curriculum implementation effectiveness. Teachers' use of these facilities is therefore the key factor to influencing the curriculum implementation outcomes and in cases of their shortfalls, the teachers could only improvise to achieve desired objectives.

A laboratory is a facility that provides controlled conditions in which scientific or technological research, experiments, and measurement may be performed. Laboratory tools refer to the various tools and equipment used by scientists working in a laboratory. The classical equipment includes tools such as safety equipment, balances, skeletons, ring stands with rings attached, burette, thermometers, volumetric flasks, crucibles, funnels, and graduated cylinders. A well-equipped laboratory provides a forum where the learner is given the opportunity to subject his beliefs, ideas, statements, theoretical proposition and so on to some experimental test through practical. In this regard, it to be noted that a school laboratory is a facility situated within the school environment used especially for students teaching and the demonstration of classroom practices. It is also referred to as a special facility within the school where experiments are done and typically contains equipment, beakers, burners and other tools necessary to complete experiments. For effective teaching and learning to be enhanced and for students' academic performance to be improved, these tools must be adequately provided and effectively utilized.

According to Uzuegbu, Mbadiwe and Anulobi (2013), the term “availability” relates to how much instructional materials are on hand, to which teachers and learners have access. It refers to the condition of being obtainable or accessible at a particular point in time. It expresses how materials can easily be gotten and used for a particular purpose and time. It also states how usable resources are upon demand to perform its designated or required functions. In this study, availability means the condition with which teachers have access and make use of functional instructional materials for effective teaching and learning. It refers to the quality, quantity, functionality and disposability of such instructional materials to teachers at every point in time for effective utilization. As a concept, it is an umbrella term that denotes the serviceability, resilience, reliability and maintainability of a component instrument. It is vital to note that the development of education in any society irrespective of its level depends largely on availability and adequacy of instructional materials.

On the other hand, utilization of instructional facilities is the process of using procured and accessible facilities, tools, equipment and appliances to make teaching and learning process easy, interesting and rewarding. Utilization, according to Raghu in Asogwa, Onu and Egbo (2013) is the primary method by which asset performance is measured and business determined. It is the transformation of a set of input into goods or services. It involves creation of value in things. Utilization, in this context, refers to the rate or how often instructional facilities are put into use or services rendered by teachers. Utilization of instructional facilities depends on their availability in the school. Flowing from the above, it is believed that if laboratory tools/equipment are adequately available and effectively utilized, students learning outcome would be affected in a positive dimension. Therefore, government at all levels must focus attention to the provision of laboratory tools/equipment in public secondary schools.

Students learning outcome are statements which specifies what a students would know or would be able demonstrate as a result of the completion of a learning process. In this regard, it is pertinent to state that leaning outcomes are usually expressed as knowledge, skills, or attitudes. According to Moon (2002), a learning outcome is a statement of what a learner is expected to know, understand and be able to do at the end of a period of learning and of how that learning is to be demonstrated. In the same vein, Donnelly and Fitzmaurice (2005) noted that a learning outcome is a statement of what the learner is expected to know, understand and/or be able to do at the end of a period of learning. Gosling and Moon (2001) emphasized that leaning outcome is a statement of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning. The Oxnard College (nd) defined students learning outcome as statements that specify what students will know, be able to do or be able to demonstrate when they have completed or participated in a Course or Program. Oxnard further specified learning outcome as an action by the student that must be observable, measurable and able to be demonstrated.

Theoretical Framework

This study was anchored on theory of constructivism developed by Piaget (1937). The theory focuses on how learners interact with their environment to develop complex reasoning and knowledge. As children interact with their environment and new objects, they learn and develop ideas. According to Piaget, knowledge is the interaction between the individual and the environment. He further asserts that experimenting and manipulation of

physical objects is the main way by which children learn. To Piaget, children's cognitive behaviour is intrinsically motivated rather than extrinsically motivated. Even if it is a fact that social interactions and other reinforcements influence how a child thinks, Piaget maintains that children learn and think naturally because they are designed and have been evolved to do so. He came up with the Stages of Cognitive Development because he believed that intellectual development is influenced by both maturation and experience. Cognitive development is indicated by a growing ability to plan, to employ strategies for remembering and to seek solutions to problems.

Piaget's theory of constructivism emphasized that people produce knowledge and form meaning based upon their experiences. Piaget's theory covered learning theories, teaching methods, and education reform. Two of the key components which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilating causes an individual to incorporate new experiences into the old experiences. This causes the individual to develop new outlooks, rethink what were once misunderstood, and evaluate what is important, ultimately altering their perceptions. Accommodation, on the other hand, is reframing the world and new experiences into the mental capacity already present. Individuals conceive a particular fashion in which the world operates. When things do not operate within that context, they must accommodate and reframing the expectations with the outcomes. This study adopted the theory of constructivism of Piaget because the theory holds that learners interact with their environment to develop complex reasoning and knowledge. And as the learners interact with objects in their learning environment such as laboratory facilities through experiment and manipulation, the learners become intrinsically motivated which tend to positively influence their learning and the development of new skills. This could also positively results in improved academic performance.

Level of Adequacy of Laboratory Equipment

Adequacy of laboratory equipment is a situation in which there is enough laboratory equipment for effective utilization in the teaching and learning of science subjects such as biology, chemistry, agricultural science, physics, mathematics, e.t.c. This adequacy of laboratory equipment is determined by the total number of students' enrolment in schools. Eshiet (1996) holds that the adequacy of laboratory facilities makes Chemistry teaching more concrete and stimulating and hence for better students' academic performance in secondary schools. Commenting on importance of adequate resources in teaching Ajayi and Ogunyemi (1990) reiterated that when facilities are provided in adequate quantity to meet relative needs of a school system, students will not only have access to the reference materials mentioned by the teacher but individual students will also learn at their own pace. The net effect of this is increased overall academic performance of the entire students. On the contrary inadequate facilities and equipment in teaching is the origin of failure (Ahmed, 1999).

Ahmed (1999) also stated that close look at the public schools in Nigeria and what goes on there shows that nothing good can come out of most schools as they do not have adequate facilities, and appropriate human resources to prepare candidates for the West African School Certificate Examination (WASCE). The National Teachers Institute (2002) asserts that the issue of facilities and materials as well as equipment for in schools and colleges has for long constituted a problem in Nigerian schools that the number of facilities equipment and materials has been generally inadequate in our schools and colleges. The learners themselves are resources to a resourceful teacher. The teacher can utilize their innate skills and ingenuity in producing certain local materials to be used as teaching aids.

Despite the fact that practical work is a unique source of teaching science, it is widely acknowledged that laboratory equipment are lacking in most schools (Omosewo, 2010). Omosewo also noted that practical work was difficult to organize as a result of lack of apparatus. Oboh (2008) opined that teaching of science subjects in most Nigerian schools is more theoretical than practical. The usual reason given is the unavailability of materials and equipment. This is supported by Danmole and Abdullahi (1990) who emphasized the importance of improving instructional strategies through the use of teaching aids. Laboratory facilities are material resources that facilitate effective teaching and learning and also promote students' performance. The inadequacy of these facilities has been noted many years back and still persists particularly with the overcrowding classes (Adesina, 1990 & Oyetunde, 2008). It was also observed that where the facilities are available, they are not usually used due to unqualified teachers and their incompetency to use the facilities. Ahmed (2003) also stated that in most of the nation's secondary

schools, teaching and learning take place under a most non conducive environment, lacking the basic materials and thus hindered the fulfillment of educational objectives.

Dike and Salisu (2015) carried out a study on inadequate laboratory facilities and utilization: pedagogical hindrance to students' academic performance in biology in senior secondary certificate examination in Zaria Metropolis, Kaduna State, Nigeria. The study revealed that laboratory facilities were inadequately available and the few available facilities were not effectively utilized. In another study, Negi, Ukwetang and Nja (2014) evaluated the adequacy of laboratory facilities on students' academic performance in secondary schools in Calabar, Nigeria. The study revealed that the available laboratory facilities were not readily enough for the teaching of chemistry and that the adequacy of facilities did not significantly contribute to the variance in students' academic performance. Also, Sankar and Ramnath (2018) examined the availability and utilization of chemistry laboratory resources in higher secondary schools. The results showed that the chemistry laboratory facilities were adequately available and the available facilities were highly utilized. Mokoro (2020) in a study in Tanzania revealed that laboratory facilities were not adequate in the schools.

Akpna (2000) investigated the relationship between adequacy of laboratory equipment and academic performance in Chemistry. The result revealed the facilities required for teaching, learning and those required for practical were adequately available in schools studied. Musah and Bah (2017) examined the Impacts of Availability and Utilization of Biology/Chemistry Laboratory Facilities and Students Academic Achievements in Secondary Schools in Yobe State, Nigeria. The findings of the study revealed that biology/chemistry laboratory facilities are either not available entirely, or where they are available they are inadequate and therefore they are not utilized by the high number of students population. There was a significant relationship between biology/chemistry laboratory facility availability and utilization, and student's academic achievement. In another study, Abudu, Banjoko & Gbadamosi (2017) examined the availability and utilization of laboratory resources and achievement of students in senior secondary school Chemistry and the result showed that most secondary schools do not have adequate resources for chemistry instruction and the few available resources are not properly utilized for chemistry instructions in schools.

Level of Effective Utilization of Laboratory Equipment

Laboratories have been found to be a primary vehicle for promoting formal reason skills and students understanding, thereby enhancing the desired outcome in students (Adeyemi, 2006). The use of laboratory equipment is of importance as they help to stimulate Learners interest and promote understanding. Utilization of laboratory equipment is the frequency with which the available laboratory facilities are used during laboratory experiments. Laboratory facilities can be available, adequate but not utilized during science teaching. The experiences gathered so far indicate that there is still much research to be done on the extent of utilization of laboratory facilities in secondary school science teaching and learning. This is why it becomes expedient to find out if teachers and students are actually utilizing laboratory facilities during Chemistry teaching (Amba and Chiwendu, 2015).

On this note, Olufunke (2012) investigated the effect of availability and utilization of physics laboratory equipment on students' academic achievement in senior secondary school physics. The results showed that the utilization of physics laboratory equipment was optimal and were effectively utilized. The federal schools had the maximum adequately utilized PLE and had the highest mean score. Also in a similar study, Abudu, Bangoko and Gbadamosi (2017) examined the availability and utilization of laboratory resources and achievement of students in senior secondary school chemistry. The result obtained revealed that most Secondary Schools do not have adequate resources for chemistry instruction and the few available resources are not properly utilized for chemistry instructions in schools.

Also, Amba and Chiwendu (2015) investigated the utilization of laboratory facilities and students' academic performance of chemistry students in Calabar, Nigeria. It was observed from the data analyzed that laboratory facilities are not adequately utilized in secondary schools for teaching Chemistry. In the same vein,

Chukwuemaka (2008) found out that the utilization of laboratory facilities/equipment in secondary schools during science teaching and learning was not effective and adequate. Also, Opara (2008) found out that during teaching and learning of science based subjects, laboratory facilities are not adequately utilized and often times the facilities were never utilized during Chemistry teaching. Oriade (2008) also investigated the utilization of laboratory facilities in Biology and the result revealed that most laboratory facilities were not adequately utilized during Biology teaching.

Adequacy and Utilization of Laboratory Equipment and Students' Learning Outcome

The availability and utilization of laboratory facilities in schools for teaching and practical enables learners to develop problem solving skills and positive attitude, interest towards science learning. However, Eshiet (1996) noted that not much attention has been given to the issue of enriching the science laboratories for effective teaching and learning of science. Lewin (2000) stated that the availability and utilization of laboratory equipment bothers on the extent to when facilities are provided to schools, these are three possibilities, they are either used effectively or inefficiently or they may remain unused. When item of equipment is maximally used such as equipment is effectively utilized. If the equipment is not maximally used it can be said to be underutilized. When there is so much pressure on the use of an equipment this may result to over utilization which could lead to breakdown of such item of equipment.

George (2016) found that inadequate laboratory facilities, and the use of ineffective teaching techniques by shorthand lecturers were the major causes of students' poor academic performance in shorthand examinations. Mfireke (2016) in his study found out that there exists significant positive relationship between teachers' utilization of laboratory facilities and academic achievement of student nurses in Human Biology. Oladejo, Olosunde, Gbolagade Ojebisi, & Isola (2011) found out that there was a significant difference in the achievement of students taught using standard instructional materials, those taught with improvised instructional material and those in the conventional instruction. Musa and Umar (2017) found out that biology laboratory facilities are either not available entirely, or where they are available they are inadequate and therefore they are not utilized by the high number of students population. There was a significant relationship between biology laboratory facility availability and utilization, and student's academic achievement.

Also, Geleta (2016) found out that shortage and ineffective use of science laboratories in the high schools correlates with poor achievements of students. The less availability, improper handling of available resources and the improper use of science laboratory items lead to the wastage of resources, less effectiveness of science laboratories and lower academic achievement of students in the high schools of the Ilu Abba Bora Zone, Southwestern Ethiopia. Okafor (2014) found out that there were no adequate functional biology laboratory facilities in the senior secondary schools in Zamfara State. The study further 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 Zamfara State. Nwachukwu (2017) revealed that the availability and utilization laboratory facilities had positive relationship with academic performance of junior secondary school students in Business Studies Etsako Federal Constituency of Edo State.

In Nigeria, there has been public outcry on the declining students learning outcome in external examinations especially in science based subjects such as mathematics, physics, chemistry, biology and agricultural science. The stakeholders in the education sector have over the years apportioned blames to the government for failing in their duties in the provision of adequate laboratory equipment to enhance effective teaching and learning. The state of school facilities especially equipment used in the science laboratory otherwise known as laboratory equipment. Over the years, researchers such as Oladare, Abiodun, and Bajulaiye (2006), Lavrenz (2006), Akpan (2006), Inyang (2006), Adesoji and Olatunbosun (2008) and Ihuarulam (2008) lamented that there are inadequate equipment for teaching and learning of science subjects in public secondary schools in Nigeria. The researchers also lamented that where there are little equipment at all, they 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 equipment are dysfunctional.

Personal observation of the researchers showed that some schools in Edo North Senatorial District, Nigeria do not have laboratory structure while some schools have blocks of laboratories without equipment. The researchers also observed that some blocks which some schools claimed to laboratories have their roofs blown off as a result of poor management and utilization of such facilities. It was also observed that in some schools where there are equipment, the available equipment are not adequate and as such equipment do not go round the students for effective learning to take place and this is seen to result to conflict among the students on who to use such equipment. It was also observed that in some schools, the few available facilities are locked inside a store by the school management and the learners do not have access to these equipment. Therefore, such laboratory equipment are not being utilized to serve its purpose.

This ugly situation observed is worrisome to the researchers and other stakeholders concerned. At this point, the researchers begin to wonder how the students cope in learning. The researchers therefore wonder if the poor state of laboratory equipment predicted the poor students learning outcome of students and how educational administrators could wade in and remedy the situation. It is therefore the interest of the researchers to find out whether the adequacy and effective utilization of laboratory equipment as predictors of secondary school students learning outcome in Edo North Senatorial District, Nigeria. Specifically, the objectives of this study are to:

- a. find out the level of adequacy of laboratory equipment in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria;
- b. find out the level of utilization of laboratory equipment in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Edo State, Nigeria; and
- c. find out if the availability and utilization of laboratory equipment predict secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria.
- d.

Research Questions

The following research questions were raised to guide the study:

- a. What is the level of adequacy of laboratory equipment in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria?
- b. What is the level of utilization of laboratory equipment in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Edo State, Nigeria?
- c. Do the availability and utilization of laboratory equipment predict secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria?

Hypotheses

The following hypothesis was formulated and tested at 0.05 level of significance

- a. Availability and utilization of laboratory equipment do not predict secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria.

Method

The study adopted the correlational research design. The population of this study consisted of all the 26,371 senior secondary school students in all the public secondary schools in Edo North Senatorial District, Nigeria. One thousand three hundred and twenty (1,320) senior secondary school students representing a proximate value of 5% of the entire population of students was drawn from the District. The simple random sampling technique was used to draw five (5%) of the students. The data for this study were collected using two instruments namely: Adequacy and Utilization of Laboratory Equipment Checklist (AUTLEC) and Students Academic Performance Inventory (SAPI). The academic performance was based on WASCE result for 2017/2018 school year in Chemistry,

Physics and Biology. The data obtained were analyzed with Percentages and Multiple Linear Regression Analysis (MLRA).

Results

Research Question One: What is the level of adequacy of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Nigeria?

Table 1: Analysis of the level of adequacy of Chemistry, Physics and Biology laboratory equipment

S/N	ITEMS	No of Students	No. of Equipment Required	No. Available in all Schools	Percentage of Adequacy	Remark
1.	Ammeter	1,320	660	94	14.24	Very Low
2.	Voltmeter	1,320	660	101	15.30	Very Low
3.	Ray-box	1,320	660	57	8.64	Very Low
4.	Weighing balance	1,320	1,320	86	6.56	Very Low
5.	Spring balance	1,320	1,320	97	7.35	Very Low
6.	Meter rule	1,320	1,320	249	18.86	Very Low
7.	Lenses	1,320	1,320	190	14.39	Very Low
8.	Tripod stand	1,320	660	546	82.73	Very High
9.	Test tube	1,320	660	1266	191.82	Adequately Available
10.	Bunsen burner	1,320	440	117	26.59	Very Low
11.	Goggles	1,320	2,640	140	5.30	Very Low
12.	Nose mask	1,320	1,320	227	17.20	Very Low
13.	Hand gloves	1,320	2,640	347	13.14	Very Low
14.	Pot	1,320	440	46	10.45	Very Low
15.	Flat bottom flask	1,320	440	178	40.45	Low
16.	Funnel	1,320	440	286	65.00	Very High
17.	Retort stand	1,320	660	290	43.94	Low
18.	Stirrer	1,320	660	123	18.64	Very Low
TOTAL			18,260	4,440	24.00	Very Low

NOTE: 0%= Not Available, 1-29=Very Low, 30-49 = Low, 50-59 = Moderate, 60-79% = High, 80-89% = Very High and 90-100% = Adequately Available.

The results in Table showed the analysis of the level of adequacy of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Nigeria. The results showed that the adequacy of Ammeter, Voltmeter, Ray-box, Weighing balance, Spring balance, Meter rule, Lenses, Tripod stand, Bunsen burner, Goggles, Nose mask, Hand gloves, Pot and Stirrer at 14.24%, 15.30%, 8.64%, 6.56%, 7.35%, 18.86%, 14.39%, 82.73%, 26.59%, 5.30%, 17.20%, 13.14%, 10.45% and 18.64%. The results also showed that the level of adequacy of laboratory equipment such as flat bottom flask and Retort stand was low at 40.45% and 43.94%. The results also showed that the level of adequacy of Tripod stand and Funnel was very high at 82.73% and 65.00% while the level of adequacy of test tube was in full. These results indicated that the level of adequacy of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Nigeria was very low.

Research Question Two: What is the level of utilization of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Edo State, Nigeria?

Table 2: Level of utilization of Chemistry, Physics and Biology laboratory equipment

S/N	Facilities	No of Facilities Available	Total No of Facilities Utilized	% Utilization	Remark
1.	Ammeter	94	15	16.00	Very Low
2.	Voltmeter	101	31	30.69	Low
3.	Ray-box	57	09	15.79	Very Low
4.	Weighing balance	86	28	32.56	Low
5.	Spring balance	97	43	44.33	Low
6.	Meter rule	249	95	38.15	Low
7.	Lenses	190	54	28.42	Low
8.	Tripod stand	546	109	19.96	Very Low
9.	Test tube	1266	322	25.43	Very Low
10.	Bunsen burner	117	49	41.88	Low
11.	Goggles	140	75	53.57	Moderately Utilized
12.	Nose mask	227	76	33.48	Low
13.	Hand gloves	347	69	19.88	Very Low
14.	Pot	46	12	26.09	Very Low
15.	Flat bottom flask	178	50	28.09	Low
16.	Funnel	286	39	13.64	Very Low
17.	Retort stand	290	99	34.14	Low
18.	Stirrer	123	45	36.59	Low
TOTAL		4440	1220	27.48	Very Low

NOTE: 0%= Not Utilized, 1-29%=Very Low, 30-49% = Low, 50-59% = Moderately Utilized, 60-79% = Highly Utilized, 80-89% = Very High and 90-100% = Fully Utilized

Table 2 showed the level of utilization of Chemistry, Physics and Biology laboratory equipment. The results showed that the level of utilization of ammeter, ray-box, tripod stand, test tube, hand gloves, pot and funnels was very low at 16.00, 15.79, 19.96, 25.43, 19.88, 26.09 and 13.64. The results also showed that the level of utilization of voltmeter, spring balance, meter rule, lenses, Bunsen burner, nose masks, flat bottom flask, resort stand and stirrer was low at 30.69, 32.56, 44.33, 38.15, 28.42, 41.88, 33.48, 28.09, 34.14 and 36.59 while the utilization of goggles was moderate at 53.57%. These results showed that the level of utilization of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Edo State, Nigeria was very low.

Hypothesis One: Availability and utilization of laboratory equipment predict secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria.

Table 7: Regression analysis on laboratory equipment and students' learning outcome

Facilities	Panel A (Availability of equipment)				Panel B (Utilisation of equipment)			
	β	t-value	P-value	Decision	B	t-value	P-value	Decision
Ammeter	43.295	48.188	.000	S	42.910	50.493	.000	S
Voltmeter	.216	2.841	.005	S	.184	2.402	.016	S
Ray-box	.181	1.595	1.111	NS	.183	1.639	.502	NS
Weighing balance	.482	4.267	.000	S	.459	4.051	.000	S

Spring balance	.095	.599	.550	NS	.107	.691	.590	NS
Meter rule	.940	2.007	.045	S	.877	1.922	.055	S
Lenses	.212	.381	.704	NS	.209	.398	.691	NS
Tripod stand	.306	.504	.615	NS	.447	.800	.624	NS
Test tube	43.892	48.438	.000	S	43.748	47.884	.000	S
Bunsen burner	.220	1.078	.281	S	.235	1.152	.250	S
Goggles	2.863	3.883	.000	S	2.463	3.509	.000	S
Nose mask	4.491	3.980	.000	S	3.497	3.273	.001	S
Hand gloves	3.511	3.475	.001	S	2.566	2.679	.007	S
Pot	.536	2.22	.027	S	.517	2.125	.034	S
Flat bottom flask	.596	2.185	.029	S	.336	1.227	.220	S
Funnel	.855	3.251	.001	S	.857	3.266	.001	S
Retort stand	.899	1.359	.174	S	1.335	2.044	.041	S
Stirrer	.130	1.074	.283	NS	.241	2.050	.041	S

Note: NS- Not significant

N- Significant

*significant at 0.05 alpha level

Dependent variable = students' academic performance

β = regression estimate (beta)

The result in Panel A of Table 3 shows the regression estimate on availability of on laboratory equipment on students' learning outcome. The result shows that the availability estimate of .000 for ammeter, .005 for voltmeter, .111 for 000, .000 for weighing balance, .045 for meter rule, .000 for test tube, .281 for bunsen burner, .000 for goggles, .000 for nose mask, .001 for hand gloves, .027 for pot, .029 for flat bottom flask, .001 for funnel, .174 for retort stand and .283 for stirrer were all significant (p -value < 0.05) while that of the other hand availability of ray-box (β =.111), spring balance (β =.550), Lenses (β =.704) and Tripod stand (β = .504), were not significant (p -value > 0.05). On the other hand, Panel B of Table 7 shows the regression estimate on utilization of laboratory equipment and students learning outcome. the result shows that the utilization indices of .000 for ammeter, .016 for voltmeter .000 for weighing balance, .000 for test tube, .250 for bunsen burner, .001 for meter rule, .000 for goggles, .001 for nose mask, .007 for hand gloves, .034 for pot, .220 for flat bottom flask, .001 for funnel, .041 for retort stand and .041 for stirrer were significant (p -value > 0.05). The results on the other hand, the utilization of Ray-box (β =.502), spring balance (β =.590), lenses (β =.691) and tripod stand (β =.624) were not significant (p -value > 0.05). This results therefore implied that availability and utilization of laboratory equipment predicted secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria.

Discussion

The discussion of findings was done as follows:

This study revealed that the level of adequacy of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Nigeria was very low. This finding might have been informed by the government neglect of public education especially at the secondary school level which has also effected the provision of adequate laboratory equipment. This finding might also have been informed by the fact that stakeholders in the education industry might have failed in playing active roles in the provision of these equipment. The finding of this study corroborates that of Dike and Salisu (2015) and Mokoro (2020) who reported that laboratory facilities were inadequately available. The finding of this study is in agreement with that of Nnegi, Ukwetang and Nja (2014) whose study showed that the available of laboratory facilities were not readily enough for the teaching of chemistry. Contrarily, the finding of this study contradicts that of Sankar and Ramnath (2018) who found out that the chemistry laboratory facilities were adequately available and the available facilities were highly utilized. The finding of this study also contradicts that of Akpna (2000) whose study revealed that the facilities required for teaching, learning and those required for practical were adequately available in schools studied. Musah

and Bah (2017) whose study revealed that biology/chemistry laboratory facilities were either not available or where they are available they are inadequate.

The finding of this study showed that the level of utilization of Chemistry, Physics and Biology laboratory equipment in public secondary schools in Edo North Senatorial District, Edo State, Nigeria was very low. This finding might have been influenced by the lack of adequate laboratory equipment in schools. The researchers are also on the view that some of the equipment available might not be in good condition. Thereof, this makes the equipment not usable and as such the utilization level of these equipment is likely to be affected in a negative direction. This finding is in support of the findings of Abudu, Bangoko and Gbadamosi (2017) who found out that the available laboratory equipment for chemistry instruction were not properly utilized for chemistry instructions in schools. This finding is also in agreement with the findings of Amba and Chiwendu (2015) whose study that laboratory facilities are not adequately utilized in secondary schools for teaching Chemistry. The finding of this study is in corroboration with the findings of Opara (2008) who found out that laboratory facilities are not adequately utilized during teaching and learning of Chemistry. However, the finding of this study contradicts that of Olufunke (2012) who found out that the utilization of physics laboratory equipment was optimal and were effectively utilized.

The finding of this study revealed that the availability and utilization of laboratory equipment predicted secondary school students' learning outcome in Chemistry, Physics and Biology in public secondary schools in Edo North Senatorial District, Nigeria. This finding might have been informed by the fact that students who are exposed to adequate and excess teaching aids are likely to perform better than those who were taught without teaching aids. The researchers also believed that the utilization of laboratory equipment makes learning concrete and as such it is likely to influence students' academic performance in a positive dimension. This finding supports the findings of George (2016) who found out that inadequate laboratory facilities were the major causes of students' poor academic performance in shorthand examinations. This finding is in agreement with the findings of Mfreke (2016) who found out that there existed significant positive relationship between teachers' utilization of laboratory facilities and academic achievement of student nurses in Human Biology. The finding of this study is in line with the findings of Musa and Umar (2017) who found out a significant relationship between biology laboratory facility availability and utilization, and student's academic achievement. The finding of this study is in corroboration with that of Nwachukwu (2017) who found out that the availability and utilization laboratory facilities had positive relationship with academic performance of students

Conclusion

Based on the findings, the study concluded that the level of adequacy of laboratory equipment was very low and the available chemistry, physics and biology laboratory equipment were also very low in their utilisation. It was also concluded that the adequacy and effective utilization of laboratory equipment for chemistry, physics and biology practical had significant positive relationship to students' learning outcome.

Recommendations

Based on the study, the following recommendations were made:

- a. The government and other stakeholders of the education industry should collaborate to equip public schools with all the necessary and required laboratory equipment to boost students' interest in science based subjects and to improve on their learning outcome.
- b. The school administrators on their parts should ensure effective utilization of all the available equipment in order to keep the few available equipment functioning.
- c. Teachers should be interested in the utilization of laboratory equipment and seek assistance and training if they lack knowledge on the utilization of these equipment as this is seen to help improve on the students learning outcome.

Implication for Educational Management

The study had found that adequacy of laboratory equipment is low in secondary schools in Edo North Senatorial District, Nigeria. This has implication for Education administrators who are tasked with the day to day

administration of schools. When laboratory equipment are not adequate, it creates a shortfall in practical based subjects and the school administrator either had to make appeal to relevant organs for supply or assistance or improvise either by borrowing or taking its students to other schools where they are available. In either way, the choices are not easy to make and this calls for managerial acumen; risks taking and in most cases, he/she may be seen as too demanding or a disturber and this must be undertaken if the students must learn and meet the 21st century global space.

The study had also found that utilisation of the equipment was low. This could have been due to power supply problem for the operation of some of the equipment or non-availability of reagents needed for smooth practical operations. The educational administrators are equally faced with the challenge of looking inward either by placing levies or dues on the students or result to external aids and these are tough decisions to make. Once more, managerial expertise is required to this regard if learning outcome of the students must be enhanced.

REFERENCES

- Abudu, K. A., Banjoko O. O. & Gbadamosi, M. R. (2017). Availability and utilization of laboratory resources and achievement of students in senior secondary school chemistry. Retrieved on the 21/07/2020 from https://www.academia.edu/15329865/availability_and_utilization_of_laboratory_resources_and_achievement_of_students_in_senior_secondary_school_chemistry
- Adesina, S. (1990). *Educational management*. Enugu: 4th Dimension Publishing Co.
- Adesoji, F.A., & Olatunbosun, S.M. (2008). Student, teacher and school environment factors as determinants of achievement in senior secondary school chemistry in Oyo State. *The Journal of International Social Research*, 1(2), 44-51.
- Adeyemi, T. O. (2006). Science laboratories and the quality of output from secondary school in Ondo state Nigeria. *Sokoto Educational Review*, 8(1), 81-87.
- Ahmed, T. M. (2003). Education and national development in Nigeria. *Journal of Studies in Education*, 10, 35-46.
- Ahmed, U.B. (1999). Mass Failure will continue until. Retrieved on 13/06/2020 from <https://pdfs.semanticscholar.org/2bdd/319002005169f5ae0f4d34ce4c82cf381ca1.pdf>
- Ajayi, K. & Ogunyemi, B. (1990). The relationship between instructional resources and socio-economic status in selected population of high school. *Dissertation Abstract International*, 25(2), 22-23.
- Akpan, O. (2006). *Laboratory facilities for chemistry teaching* (Unpublished seminar paper). University of Calabar, Nigeria.
- Amba, N. H. & Chinwendu, N. O. (2015). Utilization of laboratory facilities and students' academic performance of chemistry students in Calabar, Nigeria. *Chemistry and Materials Research*, 7(3), 57-62
- Asogwa, V. C., Onu, D. O. & Egbo, B. N. (2013). Availability and utilization of instructional materials for effective teaching of fish production to students in senior secondary schools in Benue State, Nigeria. *African Journal of Agricultural Research*, 8(49), 6601 – 6607.
- Bawa, B. (nd). Education in the process of national development. Retrieved on 25/08/2020 from <https://www.yourarticlelibrary.com/education/education-in-the-process-of-national-development/76818>

- Chukwuemaka, P. C. (2008). Efficacy of utilization of laboratory resources on the acquisition of science process skills among primary science pupils. *Paper presented at the 49th annual Science Teachers' conference STAN, Nsugbe, August 3-5.*
- Danmole, B.T and Abdullahi, A. (1990). The use of community resources for senior secondary schools science instructions. *Zaria Journal of Studies in Education, 1(1), 29-37.*
- Dike, N. & Salisu, H. (2012). Inadequate laboratory facilities and utilization: pedagogical hindrance to students' academic performance in biology in senior secondary certificate examination in Zaria Metropolis, Kaduna State, Nigeria. *International Business Research 8(9), 124-134*
- Donnelly, R & Fitzmaurice, M. (2005). Designing modules for learning. In G. O'Neill et'al (eds). *Emerging issues in the practice of university learning and teaching.* Dublin: AISHE
- Eshiet, I. T. (1996). *Improvisation in science teaching philosophy and practice.* Abak: Belpot Press.
- Federal Government of Nigeria (2013). *National policy on education.* Abuja: NERDC Press
- Geleta, T. K. (2016). The upshot of availability and utilization of science laboratory inputs on students' academic achievement in high school biology, chemistry and physics in Ilu Abba Bora Zone, Southwestern Ethiopia. *International Journal of Scientific and Research Publications, 6(9), 298-307.*
- George, E. D. (2016). *Influence of availability of instructional facilities and teachers' instructional methods on students' academic performance in shorthand in colleges of education* (Unpublished master's dissertation). Ahmadu Bello University, Zaria.
- Hornby A.S. (2006). *Oxford advance learners dictionary.* Oxford: Oxford University press
- Ihuarulam, A. I. (2008). *Chemistry teachers' perception of availability and utilization of resources for curriculum development in Kano State* (Published M.Ed. thesis). University of Kano, Nigeria.
- Inyang, N.E.U. (2006). The Status of science and maths laboratories in selected secondary schools in Akwa-Ibom State of Nigeria. *47th STAN Annual Conference Proceedings, 33-37.*
- Lavrenz, F. (2006). The relationship between science teacher characteristics and student achievement and attitudes. *Journal in Research in Science Teaching, 12(3), 433-437.*
- Lewin K. M. (2000). *Mapping science education policy in developing countries.* London: Palmer Press
- Longman (2000) Longman dictionary of contemporary english. England: Pearson Education Limited.
- Mapaderum, O. (2002). Teaching methods for business, science, social science and technical education. Ibadan: Holyem communications.
- Mfreke, U. O. (2016). Teachers' utilization of school facilities and academic achievement of student nurses in human biology in schools of nursing in Akwa Ibom State, Nigeria. *Journal of Education and Practice, 7(16), 73-80.*

- Mokoro, D. K. (2020). Adequacy of laboratory facilities for effective implementation of competence-based curriculum in public secondary schools in Arumeru District, Tanzania. *East African Journal of Education and Social Sciences (EAJESS)* 1(2), 141-149.
- Moon, J. (2002). *The module and programme development handbook*. London: Kogan Page Limited
- Musah, A. & Umar A. A. (2017). Effects of availability and utilization of biology laboratory facilities and students' academic achievements in secondary schools in Yobe State, Nigeria. *International Journal of Innovative Social and Science Education Research* 5(2), 1-8.
- Musah, A. & Bah, L. F. (2017). Impacts of availability and utilization of biology/chemistry laboratory facilities and students' academic achievements in secondary schools in Yobe State, Nigeria. *International Journal of Innovative Social & Science Education Research* 5(3), 20-28.
- National Teacher Institute (2002). Nigeria certificate in education course book on physical and health education, Kaduna.
- Neji, H. A., Ukwetang, J. O., & Nja, C. O. (2014). Evaluating the adequacy of laboratory facilities on students' academic performance in secondary school in Calabar, Nigeria. *IOSR Journal of Research & Method in Education*, 4(3), 11-14
- Nwachukwu, A. U. (2017). *Relationship between school facilities and academic performance of students in business studies in junior secondary schools in Etsako Federal Constituency* (Unpublished master's dissertation). Ambrose Alli University, Ekpoma
- Oboh, F.O. (2008). The need of improvised teaching aid for effective teaching-learning of biology. *Bichi Journal of Education*, 8(1), 64-69.
- Okafor, A. I. (2014). *Relationships between availability of laboratory facilities and academic performance in biology among senior secondary school students in Zamfara State, Nigeria* (Unpublished master's dissertation). Usmanu Danfodiyo University, Sokoto, Nigeria.
- Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & O. M. Isola (2011). Instructional materials and students' academic achievement in physics: Some policy implications. *European Journal of Humanities and Social Sciences*, 2(1), 112-126.
- Oludare O. T. Abiodun O. S. & Ajayi B. A. (2006). *The status of resources in secondary schools teaching and learning in Lagos State, Nigeria*. In U. M Nzenwi (Ed.), *47th annual conference proceedings of the science teachers association of Nigeria*. Ibadan: Science Teachers Association of Nigeria
- Omoosewo, E.O. (2010). Science laboratory management in some selected secondary schools of Moro Local Government Area of Osun State. Retrieved on 23/05/2019 from www.new.unilorin.edu.ng.
- Opara, M. F. (2008). *Utilization of laboratory facilities and students' academic performance* (Unpublished M.Ed. thesis). Anambra State University, Nigeria.
- Oriade, T. I. (2008). An empirical study of the utilization of instructional materials and laboratory resources in biology curriculum implementation. *Paper presented at the 49th annual conference of STAN, Nsugbe, August, 26.*

Oxnard College (nd). Retrieved on 25/05/2020 from <https://www.oxnardcollege.edu/committees/curriculum-committee/student-learning-outcomes-definition>

Oyetunde, A. A (2008). School size and facilities as correlate of junior secondary school student's performance in Oyo state, Nigeria. *Pakistan Journal of Social Sciences*, 5(8) 836 – 840

Piaget, J. (1937). *Origins of intelligence in the child*. London: Routledge & Kegan Paul

Sankar, S. P. K. & Ramnath, R. (2018). Availability and utilization of chemistry laboratory resources in higher secondary schools. *Review of Research*, 8(2), 1-8.