



LEVEL OF AVAILABILITY, ADEQUACY AND UTILIZATION OF CHEMISTRY LABORATORY EQUIPMENT

IDRIS NAFISAT OYIZA

Department of Chemistry Kogi State College of Education (Technical),
Kabba

Abstract

This study investigated the level of availability, Adequacy, and Utilization of Chemistry Laboratory Equipment Checklist in School in Yola-North of Adamawa State. The Study adopted the survey Research Design. A sample of 20 chemistry teachers and 140 chemistry students were used for the study. Three research questions guided the study. The instrument used was Chemistry Laboratory Equipment Checklist (CLEC). Three experienced lecturers validated the instruments after which the instrument was pilot-tested using chemistry teachers and student who were not part of the sample of the study. The liability coefficient of the instrument yielded 0.84 using Cronbach alpha method. The data collected where analyzed using mean and standard deviation. The major findings of the study were: that Chemistry Laboratory equipment were not available in most of the senior secondary schools as indicated by the respondents in Yola-North, Adamawa State: Chemistry laboratory equipment were not adequate in Yola-North senior secondary schools Chemistry laboratory equipment were not utilized in senior secondary schools of Yola-North. Recommendations were made to the Government to make Chemistry equipment available, Adequate in secondary schools for teachers and students. Recommendations were also made to the teachers in utilizing the chemistry laboratory equipment.

Keywords: Availability, Adequacy, Utilization, Chemistry Laboratory, Equipment

Introduction

Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter (Ababio, 2015). Chemistry deals with such topics as the properties of individual atom, how atoms form chemical bonds to create compounds, the interaction of substances through intermolecular forces that give matter its general properties and the interaction between substances through chemical reaction to form different substances. Chemistry is sometimes called the central science because it bridges other natural sciences, like physics, geology and biology. In the secondary school, the study of chemistry cannot be complete without practical exercises which are to be carried out in well-equipped laboratories. The laboratory according to Ekanem and Obodom (2016) is that building set apart for scientific enquiry. Musah and Bah (2017) defined laboratory as a supreme court where all scientific inventions and difficulties are carefully and systematically analyzed so that useful, dependable and assessable truth are established. In the recent times, it has been observed that there is a sharp decline in the performance of students in chemistry in the State. It has been reported that students in most of the secondary schools in rural areas never set their eyes on practical equipment until about a week to their Senior School Certificate Examination (SSCE) which will lead to students' inability to handle equipment and poor usage as a result leading to poor performance of student in chemistry examination.

Anaso (2016) and Ekanem and Obodom (2016) opined that the success of a chemistry lesson depends on the availability of materials and chemical sample to teach and demonstrate with. Anaso (2016) and Ekanem and Obodom (2016) further attributed the decline in students' performance to the poor state of science laboratories and the poor experience of some science teachers who know little or nothing about specimen collections, preparation and presentation. Therefore, students are unfortunately exposed to yearning about 'science' instead of "learning science. The science laboratory in the State has failed this because the entire working system of the laboratory in process of convincing, modifying and transforming ideas into visible facts are not effectively done, due to

inadequate laboratory facilities, and skilled teachers. Therefore, the problem of practical in chemistry can be reflected to inadequate laboratory facilities, skilled teachers, lack of regular practical in schools and the inability of students to use practical equipment effectively as a result leading to poor performance of students in practical chemistry and the subject in general.

Fundamental research among science educators and cognitive scientists focuses on how people learn science and how they apply this knowledge in their daily lives. Science education provides students with knowledge, training, and learning experience while stimulating their physical and mental growth. According to the National Science Board Commission on Pre-college Education, Mathematics, Science and Technology, in its report stressed that, most states are failing to provide its students with adequate tools, resources or facilities needed to excel in the 21st Century. It is necessary to provide students with a strong broad background in the area of science and mathematics education when laboratory facilities are adequate in schools, students should be offered opportunities to enable them grow in their problem-solving abilities, think critically and acquire scientific and technological literacy (William & Maureen, 2012).

Nath (2018) discovered that many schools that are rich in equipment, are experiencing non-utilization and underutilization of the equipment. He indicated that some of the apparatus are kept in the laboratory store room either forgotten or left there without use for many years. Sometimes, there are cases of misuse resulting to breakage and mutilation of them. This non-utilization of laboratory equipment was also reported in Chemistry by (Umar and Musah, 2019). Usman (2021)

listed some factors that militate against effective utilization of available resources in chemistry laboratory to include; in- competency of chemistry teachers, defective training given to chemistry teachers etc.

According to Ogan and Arokoyu. (2017), it is well known among educators that the educational experience involving the learner actively participating in concrete examples are retained longer than abstract experiences. In the same vein Russel et al (1985) emphasize that concrete experience facilitates learning and the acquisition, retention and usability of abstract symbols.

According to Adeoye and Papoola (2011), for learning to take place, learners must have access to necessary information materials and resources. They have to interact with tangible and intangible resources to ensure some level of performance. This is supported by Ogan and Arokoyu. (2017) who asserted that learning is strengthened when there are enough reference materials such as textbooks, exercise books, laboratory equipment, teaching aids and classrooms. He further asserted that academic achievement illustrates per excellence the correct use of these materials. Olagunju and Abiola (2008) states that utilization of resources in the teaching brings about fruitful learning since it stimulates students' sense as well as motivating them. Emendu (2013) found that availability and utilization of laboratory equipment enhanced students' performance in chemistry. Ibrahim (2013) found that availability and utilization laboratory equipment improved students' performance.

The importance of practical knowledge in chemistry cannot be over emphasized no student can adequately acquire experience which of course entails the use of laboratory equipment and materials therefore the poor performance of secondary school students in practical chemistry in the recent times necessitate the study. This study therefore, investigated the level of availability, adequacy and utilization of chemistry laboratory equipment in senior secondary school in Yola-North LGA.

Statement of the Problem

The persistent poor performance of secondary school students in chemistry in senior school certificate examination 1s causing serious concern in education circles. This is because of the vital role of chemistry education for scientific and technological advancement of this country. The West African Senior School Certificate Examination results for 2006 to 2010 shows a persistent underachievement of student in chemistry (Bayagbon, 2010 & Miden, 2010). According to WAEC chief examiners report (2010) students under achievement in chemistry can be attributed to their lack of familiarity with common chemistry laboratory equipment or apparatuses and poor knowledge in the fundamental principles and procedures for practical chemistry. This implies that senior secondary

school students are not sufficiently exposed to chemistry laboratory equipment through practical or laboratory exercises prior to senior school certificate examinations. Hence, students are unfamiliar with chemistry laboratory equipment and are unable to use them during chemistry practical examinations. Consequently, they performed poorly in chemistry in senior school certificate examinations. This study therefore, investigated the level of availability, adequacy and utilization of chemistry laboratory equipment in senior secondary school in Yola-North LGA.

Purpose of the Study

The main purpose of the study is to investigate the level of availability, adequacy and utilization of chemistry laboratory equipment in senior secondary schools in Yola-North LGA of Adamawa State. The specific objectives are to determine:

1. The level of availability of chemistry laboratory equipment in senior secondary school Yola-North LGA of Adamawa State
2. The level of adequacy of chemistry laboratory equipment in senior secondary school Yola-North LGA of Adamawa State
3. The level of utilization of chemistry laboratory equipment in senior secondary school Yola North LGA of Adamawa State

Research Questions

The following research questions are drawn based on the above stated objectives.

1. What is the level of the availability of chemistry laboratory equipment?
2. What is the level of adequacy of chemistry laboratory equipment in senior secondary school Yola-North LGA of Adamawa State
3. What is the level of utilization of chemistry laboratory equipment?

Research Design

The study adopted the survey research design. A survey research design according to Nworgu (1991) is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items

considered to be representative of the entire group. This design was considered appropriate and suitable for this study because it focused on obtaining information and analyzing data from a group of chemistry teachers and students considered to be representative of the entire population on the level of availability, Adequacy and utilization of chemistry laboratory equipment in senior secondary schools in Yola-North, Adamawa State.

Area of the Study

The study was carried out in Yola-North, Adamawa State of Nigeria. The people of Yola-North are mainly traders, industrialists and educationists. Adamawa State is located in northeastern Nigeria, with its capital at Yola. It lies between 800N and 11N and longitude 11.50 E. it was formed in 1991 from part of Gongola slate with four administrative divisions namely: Adamwa, Ganye, Mubi and Numan. It is one of the 36 states which constituted the federal republic of Nigeria and constitute many secondary schools and tertiary institutions among which are one special science school and three State government owned federal government secondary schools, Federal and State government owned Universities, Polytechnic, colleges of education and a college of Agriculture, in addition to many private secondary schools and universities. The choice of Yola-North, Adamawa State for this study is due to its accessibility and presence of many secondary and tertiary institutions where chemistry is studied.

Population of the Study

The population of the study consists of chemistry teachers and SS 2 Student in the 7 selected Senior Secondary School in Yola-North Local Government Area of Adamawa State. According to Adamawa State Post Primary School Management Board (PPSMB2015) Department of Planning Research and Statistic. there are 2418 SS2 Students and 43 Chemistry Teachers.

Sample and Sampling Technique

The researcher sampled 20 chemistry Teacher each from seven schools using simple random sampling totaling 140 students. The researcher also

used all the 20 chemistry teachers from the selected schools making a total of 160 respondents. Proportionate sampling technique was used to sample 7 out of 11 schools which constituted the population. Senior secondary year two (SS2) students were used for the study because having spent one full academic year in senior secondary year one (SS 1) they are in a better position to give information about chemistry laboratory equipment. The SS 3 students were not available for the study since they were busy preparing for the senior school certificate examination.

Instrument for Data Collection

The instrument used for this study was a Chemistry Laboratory Equipment Checklist (CLEC) drawn by the researcher from the Science Teachers Association of Nigeria chemistry laboratory equipment Checklist, West Africa Examination Council and The National Examination Councils chemistry laboratory equipment checklist. The National questionnaire comprised four parts. Part A is on teachers' general information, Part B deals with availability part C deals with adequacy of the equipment, and part D deals with the utilization of chemistry laboratory equipment. The instrument comprised a list of 50 practical chemistry laboratory equipment items, which chemistry teachers and students were requested to indicate the extent of availability, adequacy and utilization of chemistry laboratory equipment in their respective schools. A 4-point rating scale of Highly Available (HA), Available (A), Slightly Available (SA), and Not Available (NA) was used to determine the extent of availability. Similarly, a 4-point rating scale of Highly Adequate (HAD), Adequate (AD), Slightly Adequate (SAD), Not Adequate (NAD) and Highly Utilized (HU), Utilized (U), Slightly Utilized (SU), Not Utilized (NU) was used to determine the extent of adequacy and utilization respectively.

Analysis and Result

Research Question 1: What is the level of availability of chemistry laboratory equipment in senior secondary schools in Yola-North?

The data presented in the Table I is the mean scores and standard deviation of chemistry teachers and students indicating availability and non-

availability of selected chemistry laboratory equipment in senior secondary schools. From the table, 21 items have mean scores of 2.50 and above which implies that the equipment are available in the schools, while the remaining 29 equipment have means scores of 2.50 below which implies that the equipment are not available in the chemistry laboratory in senior secondary schools in Yola-North.

Research Question 2: What is the level of adequacy of chemistry laboratory equipment in senior secondary schools in Yola-North?

The data presented in the Table 1 indicates that 19 items have mean scores of 2.50 and above which implies that the equipment are adequate in the schools, while the remaining 31 equipment have means scores of 2.50 below which implies that the equipment are not adequate in the chemistry laboratory in senior secondary schools in Yola-North.

Research Question 3: What is the level of utilization of chemistry laboratory equipment in senior sec Onualy schools in Yola-North?

The data presented in the Table 1 shows that 17 items have mean scores of 2.50 and above which implies that the equipment are utilized in the schools, while the remaining 33 equipment have means scores below 2.50 which implies that the equipment are not utilized in the chemistry laboratory in senior secondary schools in Yola-North.

Table 1: Mean responses and Standard Deviation of respondents on availability adequacy and utilization of chemistry laboratory equipment.

S/NO	EQUIPMENT	Availability			Adequacy			Utilization		
		X	SD	Remark	X	SD	Remark	X	SD	Remark
1	Beaker	3.02	0.86	A	2.69	1.06	AD	2.83	1.01	U
2	Crucible	2.79	0.81	A	2.83	1.01	AD	1.87	1.06	NU
3	Crucible tongs	2.71	0.93	A	2.55	1.15	AD	1.51	0.99	NU
4	Evaporating dish	2.34	1.07	NA	2.26	1.14	NAD	1.98	1.09	NU
5	Conical flask	2.95	0.95	A	2.74	0.94	AD	2.59	0.96	U
6	Thermometer	2.86	1.06	A	2.68	1.10	AD	2.83	0.93	U
7	Pipette	3.03	0.80	A	3.03	0.89	AD	2.23	1.15	NU
8	Dropping pipette	2.92	0.89	A	2.92	0.98	AD	2.07	0.96	NU
9	First aid kit	2.67	1.14	A	2.80	0.93	AD	1.74	1.01	NU

10	Cork bores	2.20	1.08	NA	2.33	1.22	NAD	2.12	1.03	NU
11	Glass cutter	2.08	1.09	NA	2.19	1.14	NAD	2.00	1.03	NU
12	Burette stand	2.72	1.02	A	2.63	1.01	AD	2.21	1.09	U
13	Test tube holder	2.46	1.03	NA	2.63	1.07	AD	2.51	1.06	NU
14	Volumetric flask	2.69	1.08	A	2.63	1.12	AD	2.04	1.11	NU
15	Indicator	2.88	1.05	A	2.88	1.05	AD	2.50	1.07	U
16	Text tool	3.18	0.76	A	2.88	0.98	AD	2.89	1.06	U
17	Burette	2.74	1.08	A	2.68	1.14	AD	2.65	1.01	U
18	Lie big condenser	1.53	0.87	NA	1.56	0.83	NAD	1.06	0.27	NU
19	Wash glass	2.05	1.04	NA	2.32	1.10	NAD	1.79	0.94	NU
20	Flat bottom flask	2.32	1.13	NA	2.33	1.14	NAD	1.98	1.01	NU
21	Test tube brush	2.80	0.95	A	2.32	1.20	NAD	2.57	0.98	U
22	Meter rule	2.99	0.84	A	3.16	0.94	AD	2.94	0.94	U
23	Funnel	2.81	0.95	A	2.02	1.06	AD	2.53	1.13	U
24	Spatula	2.76	0.97	A	2.51	1.00	AD	2.03	1.08	NU
25	Pipette stand	2.23	1.10	NA	2.48	1.13	NAD	2.41	1.08	NU
26	Stop clock	2.54	1.06	A	2.39	1.03	NAD	2.53	0.97	U
27	Rod	2.44	1.12	NA	2.10	1.02	NAD	2.25	1.08	NU
28	Rubber stopper	2.39	1.12	NA	2.34	1.12	NAD	2.06	1.03	NU
29	Wire gauze	2.18	1.02	NA	2.09	0.99	NAD	1.99	0.95	NU
30	Filter pump	2.10	1.09	NA	2.23	1.15	NAD	1.68	0.97	NU
31	Filter paper	2.27	1.11	NA	2.29	1.08	NAD	2.55	0.97	U
32	Fire blanket	1.84	0.97	NA	2.12	1.11	NAD	1.76	1.04	NU
33	Fire extinguisher	2.23	1.11	NA	2.24	1.15	NAD	1.52	0.82	NU
34	Phenolphthalein	2.48	1.10	NA	2.33	1.12	NAD	2.61	1.02	U
35	Aspirators	1.48	0.83	NA	1.55	0.93	NAD	1.59	0.92	NU
36	Red litmus paper	2.99	0.96	A	2.90	1.04	AD	2.80	0.95	U
37	Wash bottle	1.95	0.97	NA	1.86	0.98	NAD	1.90	1.07	NU
38	Gas jar	2.19	1.09	NA	2.10	1.02	NAD	1.43	0.76	NU
39	Brush	2.80	1.10	A	2.19	1.09	NAD	2.74	0.90	U
40	Cork ring	2.05	1.11	NA	2.05	1.11	NAD	1.93	1.14	NU
41	Glass rod	2.43	1.05	NA	2.31	1.13	NAD	2.47	0.96	NU
42	Syringe	2.23	1.03	NA	2.22	1.07	NAD	2.57	1.05	U
43	Scissors	2.84	1.06	A	2.10	1.08	NAD	2.89	0.80	NU
44	Deionizer	1.98	0.98	NA	2.61	0.95	AD	1.43	0.73	NU
45	Tripod stand	2.45	1.06	NA	2.33	1.03	NAD	1.88	1.00	NU
46	Combustion boat	1.87	0.95	NA	2.23	1.11	NAD	1.33	0.64	NU
47	PH meter	2.13	1.04	NA	2.40	1.20	NAD	1.55	0.95	NU
48	Dry tube	2.10	1.16	NA	2.15	1.09	NAD	1.33	0.77	NU

49	Desecrator	1.87	1.02	NA	2.14	1.12	NAD	1.09	0.29	NU
50	Splint	1.40	0.80	NA	1.34	0.76	NAD	1.29	0.68	NU

KAY: A=Availability; NA=Not Available; AD=Adequate; NAD= Not Adequate' U=Utilized; NU= Not Utilized.

Discussion of Results

The availability, adequacy and utilization of chemistry laboratory equipment will not only enhance the teaching of chemistry, but will help the students to acquire the much talked about process skill in chemistry and develop student's positive attitude towards chemistry. This study reveals chemistry laboratory equipment are not available enough in senior secondary schools in Yola-North. Of the 50 items on the checklist, only 21 of the equipment are said to be available while the rest of the equipment are not available. The absence of these chemistry equipment in senior secondary schools could be one of the reasons why chemistry teachers do not start chemistry practical aspects of the chemistry curriculum early, alongside with the theoretical aspects (Njoku, 2007). This discovery of non-availability of chemistry equipment in school is in line with Asiyai (2006) findings. Asiyai result reveals that most secondary schools do not have the instructional resources for teaching chemistry. Consequently, non-availability of these resources has a link to students' poor performance in chemistry.

Findings related to research question two in table I revealed that the chemistry laboratory equipment in senior secondary schools in Yola-North are inadequate. This is because of the 50 equipment in the checklist, only 19 were indicated by the respondents to be adequate while the remaining 31 were inadequate. This finding is related to those of researchers such as Onabanjo and Akinsola (2000); Oladare, Abiodun and Bajulaye (2006); Okafor (2000) who stated that there are inadequate resources for teaching and learning of science subjects in public secondary schools.

The Chemistry Laboratory is a place where the teacher and students can do practical work. Unfortunately, the respondents indicated that only 17 out of 50 the chemistry laboratory equipment are utilized. This in general implies that chemistry teachers do not utilize the available equipment and

this in return could lead to poor attitude and low achievement of students. This result is supported by observation of earlier researchers (Achufusi, Umeh and Okoye 2009; Utulu 1998; and Ochu 2010), This findings on unavailability and non-utilization of chemistry laboratory equipment is also in conlorimity with the findings of Onabanjo and Akiusola (2000); Oladare, Abiodun and Bajulaiye (2006), Uyoata (2006); Laval (2006). and Akano and Akpokiere (2006), for Oyo, Lagos, Akwa-lbom, Delta, Kastina, and Niger States.

Conclusion

The availability, adequacy and utilization of chemistry laboratory equipment affect the chemistry students' achievement in senior secondary schools in Adamawa State.

While Nigeria needs to be developed like other countries in the world; the availability and utilization of the chemistry equipment should be taken seriously in the secondary schools. To be developed educationally, the curriculum of each subject should be put into consideration. For example, the contents in the senior secondary chemistry curriculum are designed to facilitate the acquisition of entrepreneurial skills among the students, thereby helping in solving global economic crisis but this is not achieved in secondary schools.

The non-availability, inadequacy and non-utilization of chemistry laboratory equipment could be one of the reasons for mass failure of chemistry in schools both for internal and external examinations. This finding on unavailability and non-utilization of chemistry laboratory equipment 1s in conformity with the findings of Onabanjo and Akiusola (2000); Oladare, Abiodun and Bajulaiye (2006), Uyoata (2006); Asiyai (2006); Laval (2006), and Akano and Akpokiere (2006); for Oyo, Lagos, Akwa-Ibom, Delta, Kastina. and Niger States. Laboratory training is very necessary in our schools. Laboratory training trains students mind to critical evaluation of facts and principles. elucidates theoretical work, promotes retain learning and discourage role learning. When the Laboratory equipment are available, adequate and students are familiar with them as well as using them, then the school of today will be providing

tomorrow's employees, people whose gifts and abilities must be developed to prepare them for life in the rapidly changing society.

Recommendations

1. The State and Federal Government should equip the chemistry laboratory by supplying the necessary laboratory equipment to schools.
2. Chemistry teachers should be sponsored to workshop, seminars and conferences by heads of their respective institutions. Through such workshop and conference, the teachers will be more dedicated to their duties.
3. Chemistry teachers should use the available chemistry equipment in school and should show some dedication and commitment to duty.
4. When performing chemistry practical, teachers should engage their students in the activities so that they can develop the right type of attitudes to chemistry lesson.
5. Policies and guidelines should be formulated for the efficient use of science laboratories for teaching and learning purpose.
6. Zonal science laboratory equipment centers with the sole function of providing laboratory equipment for science teaching should be set up for the furnishing of laboratories in schools.

Acknowledgement

The Author is grateful to Adamawa State Post Primary School Management Board (PPSMB2015) Department of Planning Research and Statistic for providing some statistics data needed for the research.

References

- Ababio, Y. O. (2015). *New school chemistry senior secondary school*. Africana publisher plc. 5th edition.
- Akano, B.U & Akpolaere R (2006). *The status of human and material resources for teaching the basic science in colleges of Education in Niger State*. 47th STAN Annual Conference and inauguration conference 27-32.
- Akinsola, M. K. (2000) *Enriching Science, Technology and Mathematics Education: Effect of resources utilization on students' Achievement in Geometry*. 41st STAN Annual Conference Proceedings, 289-291.

- Anaso, J.N. (2016). Assessment of the laboratory resources in chemistry: A case study of secondary schools in Zamfara central zone, Zamfara state, Nigeria. *Journal of Research and Development*. 10(1) 11-27
- Asiyai R.F (2006). *An appraisal of the adequacy of the physical resources available for teaching chemistry in secondary schools in Delta State*. 47th STAN conference proceedings, 196-200
- Bayagbon, M. (2010). 62, 295 Obtain credit in English, Maths, 3 other subject and WAEC releases Nov/Dec WASSCE results. Vanguard Friday, December 24, 2010 P. 6.
- Ekanem, N. U. and Obodom, M. I (2016). Availability of scientific equipment in the laboratory and students' academic performance in chemistry in senior secondary schools in Akwa Ibom
- Emendu N.B. (2013). *Effects of Availability and Utilization of Chemistry Laboratory Equipment on students' Achievement in Chemistry*. Nnamdi Azikiwe University Awka, Anambra State.
- Federal Ministry of Education, Science and Technology, (2013). *Core Curriculum on Chemistry*. Lagos: Ministry of Education. Federal Republic of Nigeria, (2013). *National Policy on Education 4th Edition*. Lagos: NEVD Press.
- Ibrahim, D.S (2013). *Investigation into the Provision and Utilization of Laboratory Facilities and Students' Performance in Practical Biology in Gombe State, Nigeria*. Retrieved From Gombe State University, Nigeria.
- Mideno, B. (2010). *UBEB blames lack of textbooks for mass failure in NECO*. Vanguard, Thursday September 23, 2010.
- Musah, A. and 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
- Nath, R. (2018). Availability and utilization of chemistry laboratory resources in higher secondary schools. <https://www.researchgate.net/publication/330701664>
- Njoku, Z.C. (2007). Comparison of students Achievement in three categories of Question in SSCE Practical Chemistry Examination. *Journal of Science Teachers Association of Nigeria*, 42. (1&2), 67-72.
- Umar, A. A and Musah, A (2019). Relationship among availability, adequacy and utilization of biology laboratory facilities and students' academic achievements in secondary schools in Yobe state, Nigeria. *International Journal of Innovative Social & Science Education Research* 7(1):45-55
- Usman, M. (2021). Availability of laboratory equipment on chemistry in senior secondary school students and its effect on students' academic performance in Sokoto south local government, Sokoto state, Nigeria. *International Journal of Multidisciplinary Research and Growth Evaluation* 4(2), 600-606
- Nworgu, B.G. (1991). *Educational Research, Basic Issues & Methodology*. Ibadan: Wisdom Publisher Ltd
- Ochu, A.N.O. (2010). *Global Economic meltdown and the challenges of functional chemistry education programme in Nigeria: The way out*. 51st STAN Annual Conference Proceedings 299-325.
- Ogan, I. & Arokoyu, A. (2017). Availability and utilization of laboratory kits for practical teaching of mathematical skills in chemistry. *American Journal of Mathematics and Statistics*, 7(4), 160-165.
- Okafor, P.N. (2000). Difficult concepts in Physics as experienced by senior secondary students in Akwalbom State. *Journal of Research Information in Education*, 1(1), 114-121.
- Oladare, O.T.; Abiodun, O.S. & Bajulaiye, B.A (2006). *The Status of resources in Secondary School; Teaching and Learning in Lagos State, Nigeria*. 47th STAN Annual Conference Proceedings, Pp 14-21.
- Onabanjo, T.O. & Akinsola, O.S. (2000). *An Investigation into the Utilization of the Available Resources in mathematics Classroom*. 41st STAN Annual Conference Proceedings, 284-288.

- The West African Examinations Council (2006-2010) Chemistry Chief Examiners, Reports. Lagos: Megavons (w.a) LTD, May/June
- Umeh, M.O. (2006). *Availability and use of human and material resources in teaching of Ecology and genetics in Biology Education in Senior Secondary Schools in Anambra State*. Proceedings of the 47th STAN Anniversary Conference 128-133.
- Uyoata, U.E (2006). *Availability, Selection and Utilization of Instructional Resources for teaching primary science in Uyo Local Government Education Authority, Akwa Ibom State*. 47th STAN Anniversary Conference Proceedings, 38-44.