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Availability of Laboratory Equipment And Students' Performance in Chemistry

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Abstract

The study investigated the availability of laboratory equipment and students' performance in chemistry. 120 senior secondary one (SSI) students in Ikot Local Government Area obtained through simple random sampling technique from five secondary schools formed the sample size for the study out of a target population of 1,980 SSI students during the 2008/2009 session. Three research questions guided the study. Three null hypotheses were formulated and tested at 0.05 alpha level using a 20-item achievement test. Findings showed that there was a significant difference between the performance of students who were adequately exposed to laboratory equipment and those inadequately exposed. There was no significant difference between the performance of students in schools with chemistry teachers having adequate knowledge of laboratory equipment and those with inadequate knowledge.

A significant difference existed between the performances of the students taught by qualified teachers and those taught by unqualified chemistry teachers. Based on the findings, it was recommended among others that government and school administrators should organize workshops, seminars and conferences to update teachers' knowledge on effective utilization of laboratory equipment in chemistry and make learning effective and interesting by equipping laboratories with adequate equipment.

Introduction

Chemistry is empirical in nature and involves chemical phenomena that requires investigations, observations and recording of reactions using reagents and equipment. As a natural science, chemistry requires understanding, development and application for it to be meaningful. Instructional science laboratories are widely regarded as a key component of science instruction because most sciences are activity – based explorations into the natural world. (American Association of Advancement of science 2006).

The study of chemistry for instance, is facilitated by adequate supply of functional laboratory equipment. Chemistry requires practicals to enhance conceptual understanding as this is crucial to students learning. The quality of functional laboratory equipment a school has is an important aspect for facilitating the knowledge of chemistry among its learners. As Wasagu (2008) puts its, 'laboratories, workshops and studies blistering with technology and state of the art equipment assisted with multimedia technology will boost academic progress'.

Ahme (2007) encouraged children to discover for themselves through spontaneous interaction with concrete objects in the environment. Aladejana (2007), Balogun (2000) and Mayer (2004) opined that available functional laboratory equipment promote students' participation during laboratory activities which in turn enable them identify problems, pose relevant questions, perform efficient and effective experiments, make judgments on alternative hypotheses and interpretation of data. Students therefore, learn to discover, learn from discovery and learn by discovery.

Availability of chemistry equipment plays a vital role in determining the achievement level of both teachers and students. Abimbola (2001) stated that one major aspect of science education that has been of great concern is the area of availability and effectiveness of use of specialized science equipment, facilities and instructional materials. Functional, usable and able-to-easily manipulate chemistry laboratory equipment has major benefits as it makes each lesson content more comprehensible, minimizes forgetting, leads to knowledge transfer, help learners acquire favourable attitudes toward a particular subject and learning in general. Practical work with available functional equipment stimulates learners' interest in chemistry especially when they are made to personally engage in useful scientific activities and experimentation. A learner acquires skills and knowledge in any science learning situation if he is given the opportunity to do activities ranging from experimenting, hypothesizing to make inferences and verifying results. Millar (2004) stated that to improve the performance of students and the quality of chemistry teachers produced, a sustainable chemistry curriculum should move towards more project-based and inquiry focused learning environment that supports natural complexity of content, avoid over simplification, encourage collaboration and present instruction in the context of authentic scientific
investigation. Pwal (2000) observed that chemistry is experimental in nature
and that available laboratory equipment help learners enhance their scientific understanding through observing, classifying, counting, measuring and interacting with objects and events of scientific interests which in turn influence achievement of the learners.

Teachers are custodians of knowledge and knowledge cannot be achieved without enough working facilities provided for the teacher's use to improve learners' performance. Working with enough tools provide stimulus on interest and motivation on the part of the learner provided the teacher has knowledge of their utilization. Availability of equipment offers the chemistry teacher the advantage of an immense variety of methods and techniques with which he could present

information, principles and skills. An effective teacher is one who strategically positions himself to map out and render meaningful practical strategies (Etiubon 2009) and engage students' minds on practical activities (Oyebanji 2000). Teachers who know how to make use of laboratory facilities and equipment to the advantage of the students get desired results (Aladejana & Aderibigbe 2007). Schools that ensure that everyequipment needed for practical activities are available, functional and in place make work easier for teacher and facilitate students understanding of laboratory activities.

Teacher training by way of qualification for professionalism enhances his knowledge of laboratory equipment and facilities utilization and its application in imparting scientific skills on its learners. Ciwar (2005) asserted that minimum requirement is not the acquisition of certificates only but also the production of evidence to show acquisition of specialized skills. The teacher must be well equipped with adequate and appropriate professional and academic knowledge and skills that will enable him to be an excellent practitioner and professional in the art of laboratory best practices. Berliner (2002) opined that teacher qualification in terms of certification is not a determinant of a teacher's effectiveness in chemistry laboratory facility utilization and thus, does not determine the students performance. Teachers need a long period of specialized intellectual training on appropriate teaching laboratory equipment in chemistry as a panacea for effective productivity.

Statement of Problem

Little advancement has been made on the status of acquisition of chemistry practical skills in the laboratory and for classroom learning due to inadequate, substandard and to a large extent non-availability of equipment in our laboratories. Laboratories with state of the art equipment and other facilities that can enhance learning efficiency and promote excellence in chemistry teaching are grossly lacking and inadequate. This has hampered learning. A growing number of students experiencing school failure are chemistry students and this is attributed to factors such as poor state of chemistry laboratories, depreciating infrastructure, poor teaching approaches leading to low level of achievement in chemistry (Ogunmade, 2006). Chief Examiner's report (2009) show that despite the improvement in the subject, students performance in chemistry is poor due to inadequate exposure to practical work and their non-acquisition of relevant skills

in carrying out related laboratory activities. Most teachers lack appropriate qualification that enhance training on skills to manipulate chemistry practical equipment even when they are available, hence cannot effectively impart skills and knowledge to students for positive learning outcome. Presently, a number of chemistry teachers lack the adequate knowledge; remain largely untrained and unskilled on laboratory equipment use and practical activities. If the teacher has the right knowledge and utilizes available laboratory equipment effectively, students' rating of their performance in external and internal examinations will be encouraging.

Purpose of the Study

The study investigated the relationship between availability of chemistry equipment and students' performance in chemistry.

Research Questions

1. Is there any difference between the performances of chemistry students in schools with adequately equipped laboratory and those in schools with laboratory nadequately equipped?
2. Does any difference exist between teachers with adequate knowledge of laboratory equipment and those with inadequate knowledge of laboratory equipment on students' performance in chemistry?
3. Is there any difference between teachers' qualification and students' performance in chemistry?

Research Hypotheses

1. There is no significant difference between the performance of chemistry students in schools with well-equipped laboratory and schools not well-equipped

2. There is no significant difference on students' performance in schools having teachers with adequate knowledge of chemistry laboratory equipment and those with inadequate knowledge

3. There is no significant difference on students' performance in chemistry taught by qualified teachers and those taught by unqualified teachers.

Research Method

A survey design was adopted for this study. The study population was made up of all senior secondary one (SSI) chemistry students of about 1,980 in Ikot Ekpene Local Government Area of Akwa Ibom State. Sample size for the study was 120 students drawn through random sampling of five secondary schools.

Availability of Chemistry Laboratory Equipment Questionnaire (ACLEQ) was used to determine students' exposure to laboratory equipment. Chemistry Achievement Test (CAT) was used to test students' performance in chemistry. Questionnaire instrument was scored as strongly Agree (SA) – 4 points, Agree (A)-3 points, Disagree (D) – 2 points and Strongly Disagree (SD) – 1 point. CAT, a 4-option objective test with 20-items was scored 5 points and question wrongly answered scored zero (o).

Validity/Reliability of Instrument

The instrument (CAT) was face validated by two experienced secondary school teachers and 3 science educators of measurement and evaluation in Science Education Department of University of Uyo. It was trial-tested on twenty (20) chemistry students in two (2) schools not selected for the study. The reliability coefficient determined using kuder-Richardson formula-21 (KR-21) was 0.81.

Data Analysis

Data for the study were analyzed using t-test of Means and Standard Deviation

Results

Table1: t-test analysis of students' exposure to chemistry laboratory equipment.

Variable	N	$\overline{X}$	SD	Df	t_{cal}	t_{crit}	Decision of 0.05 alpha
Adequately equipped laboratory	64	47.50	14.72	118	3.54	1.98	* Significant
Inadequately equipped	56	38.68	11.01				

Results in Table 1 showed that the observed t-value for the difference between the performance of students exposed to adequately equipped chemistry laboratory and those exposed to inadequately equipped laboratory is 3.34 while the corresponding critical value t_{crit} at df = 118 and 0.05 alpha level of significance is 1.98.. There is therefore a significant difference between the performance of students exposed to adequately equipped chemistry laboratory and those exposed to inadequately equipped laboratory equipment. Null hypothesis 1 is therefore rejected.

Table: 2 t – test analysis of students' performance in chemistry classified by teacher's knowledge of laboratory equipment.

Variable	N	$\overline{X}$	SD	Df	t_{cal}	t_{crit}	Decision of 0.05 alpha
With adequate knowledge	72	46.85	21.73	118	0.48	1.98	*Not significant
With inadequate knowledge	48	45.59	15.33				

The results in Table 2 showed the t value for difference in performance of students with teachers having adequate knowledge of chemistry laboratory equipment and teachers with inadequate knowledge of laboratory equipment as 0.48, while its corresponding critical value at df =118 and 0.05 alpha level is 1.98. The t_{cal} is less than the t_{crit}, hence, there is no significant difference between the performance of students taught by teachers with adequate knowledge of chemistry equipment and those with inadequate knowledge of laboratory equipment. Thus, null hypothesis 2 was upheld.

Table 3: t- test analysis of students' performance in chemistry classified by teachers' qualification.

Variable	N	$\bar{X}$	SD	Df	t_{cal}	t_{crit}	Decision of 0.05 alpha
Qualified	72	47.64	11.29	118	2.21	1.98	* Significant
Unqualified	48	42.65	12.58				

Note: B. Sc, HND, M.Sc (Ed), Ph.D as qualified

NCE, OND as unqualified

The results in Table 3 above showed that the observed t_{value} (t_{cal}) for the difference in the performance of students taught by qualified teachers and those taught by unqualified teachers is 2.21, while its corresponding critical value, t_{crit} at df = 118 and 0.05 alpha level of significance is 1.98. The t_{cal} is greater than the t_{crit}. , hence the null hypothesis 3 was rejected.

Discussion of Findings

The findings of the study in Table 1 showed a significant difference between the performance of students exposed to adequately equipped chemistry laboratory and those exposed to inadequately equipped laboratory. These findings are in agreement with Pwal (2000) who stated that chemistry is experimental in nature and available laboratory equipment enhances learners' scientific understanding and interacting with events and objects of scientific interest which in turn influence the achievement of learners.

Results of findings in Table 2 in respect to the difference between the performance of chemistry students in schools with chemistry teachers having

adequate knowledge of laboratory equipment and those with inadequate knowledge of laboratory equipment showed no significant difference. These findings do not agree with (Aladejana & Aderibigbe 2007) who opined that teachers who know how to make use of laboratory facilities and equipment to the advantage of the students carry them along as they arouse in the students the interest and desire to know and experience, and thus are able to get the desired learning outcomes.

Findings in Table 3 showed a significant difference in the performance of students taught by qualified chemistry teachers with knowledge of laboratory equipment and those taught by unqualified teachers. These findings are in line with those of (Ciwar 2005) who found that minimum requirement is not the acquisition of certificates only but also the production of evidence to show acquisition of specialized skills and that teachers must be well equipped with adequate and appropriate professional and academic knowledge.

Conclusion

Consequent upon the findings of this study the exposure of chemistry students to laboratory equipment strongly influenced their performance in chemistry. However, the knowledge possessed by chemistry teachers on laboratory equipment does not determine the performance of the students. Qualification of the teacher in terms of certification strongly determined the performance of students in chemistry. Only a well-trained teacher can improve the performance of his students. Quality education for quality teacher impartation of knowledge on its student on use of laboratory equipment is a pre-requisite requirement for changing teaching trends in secondary school education.

Recommendation

1. It is imperative that schools improve the quality of chemistry laboratories with functional, utilizable, user-friendly equipment to sustain students' interest in chemistry.
2. Chemistry teachers should attend conferences, workshops and seminars for exposure on training in handling and using laboratory equipment that helps to update knowledge on scientific practical initiatives.
3. School authorities should partner with private organizations to produce equipment relevant to current technological and scientific needs.
4. Government and other stakeholders in education should sponsor teachers to training institutions for additional basic qualifications that improves teacher performance on chemistry teaching.

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