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An investigation into the Extent of use of Practical Activities in Teaching Chemistry in Nigerian Schools

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Abstract

Students' performance in chemistry in the senior secondary school certificate examination (SSCE) conducted by the West African Examination Council (WAEC) and the National Examination Council (NECO) has not improved appreciably in the recent past. Among the factors responsible for this unsatisfactory situation is inadequate practical activities to which students are exposed in the teaching-learning process of chemistry. This study investigated the extent to which practical activities are used in teaching and learning of chemistry in senior secondary schools. Four research questions guided the study. The study was carried out in Nsukka Local Government Area of Enugu State, Nigeria. The research adopted descriptive survey design. A sample of one hundred and forty (140) SSIII students and twenty (20) chemistry teachers from 10 out of 31 senior secondary schools were used for the study. The instrument was sixty-four (64) items questionnaire used for data collection, Descriptive statistics were used to analyze the data and answer the research questions. The reliability co-efficient of the instrument was 0.87, calculated using Cronbach Alpha method. The study found that: teachers do not use practical activities effectively in teaching chemistry; students are not fully involved in practical activities in learning chemistry; scheme of work in chemistry is not adequately covered; and chemistry practical activities are started late towards the end of chemistry course in the final year class. It was recommended, among others that well-equipped laboratories be provided to the schools by school proprietors; seminars, workshops and conferences should be organized for teachers and students to see the need to carry out all the practical activities recommended in the curriculum for teaching and learning chemistry.

Key words: Practical Activities, Teaching, Chemistry

Introduction

Chemistry as a branch of science studies matter, its structure, composition, properties and its transformation. The study of chemistry aims at helping learners to acquire appropriate skills, abilities and competencies that would enable them contribute to the development of society. Okorie (2014) noted that chemistry is pivotal to the transformation and development of nations because it has continued to play an increasingly important role in the production of many technologies, from life-saving pharmaceuticals to computers and other information technologies. The author observed that because of the central role it plays in the successful study of science-based courses such as medicine, pharmacy, biochemistry, engineering, agriculture and several others, chemistry is regarded as a 'central science' and this underlines the importance and need to study it.

Anugwo and Asogwa (2015) argue that chemistry has contributed greatly towards providing our basic needs and improving the quality of life. The knowledge of chemistry has been used in production of fertilizers and insecticides, which have aided greatly to ensure increased food production, preservation and storage for the teaming population. Man-made textile fibers are produced as a result of research in chemistry and chemical technology. Many high-rise buildings need materials like cement, concrete, steel, bricks and tiles produced by chemical industries. The improved mechanical properties of these materials are because of research in chemistry. Bleaches, disinfectants and soaps are various chemical products from the knowledge of chemistry.

A number of problems, which constitute a significant factor besetting education in chemistry in Nigerian secondary schools, are well documented in literature. The problems include dearth of well-trained chemistry teachers, inadequate supply of chemistry laboratory resources (including laboratory technologists and inappropriate pedagogical approach adopted by teachers. Other problems include students' negative attitude and loss of interest in the subject. Okorie and Akubilo (2013) suggested that 'these problems cannot be solved simultaneously, but gradually and systematically', starting from the classroom, to ascertain what goes on therein, with focus on the teacher. Nnachi (2011) had observed that crisis in education system results from teachers' inability to implement the curriculum. This observation was assumed an indication that teachers were 'not conversant with the recommended pedagogical approach of the curriculum' (Okorie and Akubilo, 2013). Consequently, the authors investigated secondary school chemistry teachers' knowledge of chemistry curriculum that they implement in schools. Okorie and Akubilo (2013) argued that the investigation was necessary because 'teachers are the drivers of the education system and managers of the classrooms; they control what goes on in classrooms and teach the students based on their knowledge, understanding and interpretation of the curriculum philosophy, objectives, content and the recommended pedagogical approach to its implementation'. The study showed that about 80% of teachers are knowledgeable about the various dimensions of the new chemistry curriculum. The authors asserts that lack of knowledge of the curriculum on the part of teachers, which very often is given as one of the contributing factors to students' underachievement in chemistry may after all be unfounded.

Teachers' adequate knowledge of the curriculum is essential for effective and efficient delivery of lessons to students. Therefore, inadequate knowledge of aspects of the curriculum, say in its implementation, is bound to bear on teachers' effectiveness, and consequently reflect on students' learning and learning outcome.

Since it has been shown that chemistry teachers are knowledgeable about the NERDC curriculum that they implement, it should be of interest to know how they implement the curriculum in the classroom. One may then ask, do teachers adhere to the pedagogic approach recommended by the curriculum? The teacher's guide to the curriculum noted that the numerous practical activities suggested for teachers and the students in the curriculum should be carried out in order for the students to achieve the objectives of the curriculum. It would be of interest to find out the extent to which practical activities are used in the teaching-learning process in the schools.

Njoku (2007) noted chemistry students' declining achievement in the three categories of quantitative analysis, qualitative analysis and theory to practical chemistry and attributed it to wrong ways of teaching chemistry, not only in the theoretical aspects of chemistry but also the practical activities involved in teaching chemistry. Okorie (2017) discussed the need for teachers and students of chemistry to devote more time to practical chemistry as a basis for deeper understanding of the concepts of chemistry. The author asserted that the practical work in chemistry is complimentary to the theoretical aspect because this is where students learn firsthand that compounds and reactions described in lecturer are not mere abstract notations. Practical activities in chemistry consist of those learning experiences in which there are interactions with apparatuses and instances of scientific principles or concepts. Mathew (2003) opines that practical work in chemistry entails simply students' physical manipulation of pieces of equipment; observing reaction, taking measurements, etc and investigating aspects of chemistry, through the use of a wide range of written resource materials.

Chemistry is an experimental science and therefore needs a high level of practical activities for its development and application. Fasakin (2003) observed that practical chemistry at the senior school certificate level is aimed at training students in the scientific techniques of recording observations accurately and drawing reasonable inferences. The author added that students of practical chemistry are expected in addition to be able to carry out experiments, making use of the simple glasswares and procedures. Nnaobi, (2008), submitted that practical activities in chemistry offer students the opportunities of gaining hands-on-experiences in the safe handling of chemical apparatuses. The researcher opined also that practical chemistry generally provides valuable training in the identification, assessment and control of risk-procedures, which can be applied to the management of other activities.

Researchers (Ezeudu, 2013; Muhammad, 2014) have noted with much concern observations in literature of secondary school chemistry students' persistent low achievements in chemistry practical examination. Secondary school students' achievement in chemistry is related to the use of practical activities in teaching and learning of the subject. If the use of practical activities is low, achievement could consequently be low. Could secondary school students' poor achievement in chemistry practical examinations be as a result of lack of use of practical activities in teaching chemistry in schools? The problem of this study put in a form of question is: what is the extent of use of practical activities in teaching chemistry in secondary schools?

Purpose of the Study

The purpose of this study was to investigate the extent of secondary school teachers' and students' involvement, the use of practical activities in the teaching and learning process of secondary school chemistry. Specifically, the study sought to ascertain the extent of

1. use of practical activities by teachers in teaching chemistry;
2. students' involvement, the use of practical activities in the teaching and learning process of chemistry;
3. coverage of the practical chemistry scheme of work; and
4. ascertain the class level at which students start practical activities in chemistry.

Research Question

1. What is the extent of use of practical activities by teachers in teaching chemistry?
2. What is the extent of students' involvement in practical activities in chemistry?
3. What is the extent of coverage of the practical chemistry scheme of work?
4. At what class level do students start practical activities in chemistry?

Research Method

This study adopted the descriptive survey research design. The area of the study was Nsukka Local Government Area of Enugu State, Nigeria. The choice of the local government area was because the researchers are familiar with the area and could adequately monitor the data collection. The population of the study was all the senior secondary school III chemistry students and their teachers in Nsukka Local Government Area for 2014/2015 academic session. The choice of this grade of senior secondary school students was because the topics chosen for the study are in their scheme of work. Senior secondary school III chemistry students were expected to have covered the topics at the period of this study, in preparation towards their external examinations in 2015. A sample of one hundred and forty (140) SSIII students and twenty (20) chemistry teachers were used for the study. Ten schools out of thirty-one (31) senior secondary schools in the area were selected using stratified random sampling technique, by choosing three Boys school, three Girls school and four Mixed schools. Fourteen (14) students from each of the school were randomly picked without replacement. The instrument used for the study was structured questionnaire developed by the researchers based on the research questions. The scheme of work used was designed, drawn and adopted by Nsukka Secondary Education Board, based on NERDC chemistry curriculum for senior secondary schools in Nigeria.

The items in the instrument were formulated on the four-point Likert-rating scales as follows: Teaching experiment with practical- (4 points), Teaching experiment with demonstration- (3 points), Teaching experiment theoretically- (2 points), and No class held-(1 point). The instrument was validated by three (3) experts in measurement and evaluation and two (2) chemistry education specialists. The instrument was also trail tested on ten SSIII chemistry students selected from two secondary schools in Udenu Local Government Area of Enugu State. The reliability of the instrument was calculated using Cronbach Alpha method and found to be 0.87, adjudged to be of high internal consistency. 170 copies of the instrument were administered to the students and teachers of the schools under study by the researchers on the spot and returned as well.

The research questions were analyzed using descriptive statistics: mean and percentage. An average score of 50 and above was the benchmark that indicated high extent of use of practical activities in chemistry teaching and learning of chemistry.

Result

Table 1: Average and percentage of extent of use of practical activities by teachers in teaching chemistry

	No. of Teachers	No. of Items	Teaching with practical activities(P)	Teaching with demonstration (D**)**	Teaching experiment theoretically **(T)**	No class held (N)
Total	20	64	484	194	374	228
Average			24.2	9.7	18.7	11.4
%			37.8	15.2	29.2	17.8

Table II Average and percentage of the extent of students' involvement in practical chemistry.

	No. of Students	No. of Items	Practical activities(P)	Mere demonstration (D**)**	Theoretically **(T)**	No class held (N)
	140	64	2588	1257	1434	3592
Average			18.5	8.97	10.24	25.6
%	Boy	Boy	28.9	14.0	16.0	40.0

Table IIIA Average and percentage of the students' extent of coverage of the practical chemistry scheme of work

	No. of students	No. of Items	Practical activities(P)	Mere demonstration (D)	Theoretically (T)	No class held (N)
Total	140	64	2590	1750	3654	980
Average			18.5	12.5	26.1	7.0
%			28.9	19.5	40.8	10

Table IIIB Teachers' extent of coverage of the practical chemistry scheme of work

	No. of Students	No. of Items	Practical activities(P)	Mere demonstration (D	Theoretically	No class held (N)
Total	20	64	484	195	374	227
Average			24.2	9.7	18.7	11.4
%			37.8	15.2	29.2	17.8

Table IVA: Students' responses on the level at which they start practical activities in chemistry

S/N	Terms	No. of Students	No. of Items	Average (P)	% (P)
1	SS I First Term	140	11	1.36	21.5
2	SS I Second Term	140	10	1.89	18.9
3	SSI Third Term	140	9	1.86	20.7
4	SS II First Term	140	10	4.35	43.5
5	SS II Second Term	140	9	3.22	35.8
6	SS II Third Term	140	10	3.19	31.9
7	SS III First Term	140	5	1.55	3.10

Table IVB: Teachers' responses on the level at which they start practical activities in chemistry

S/N	Terms	No. of Teachers	No. of Items	Average (P)	% (P)
1	SS I First Term	20	11	2.0	18.2
2	SS I Second Term	20	10	1.5	15.2
3	SSI Third Term	20	9	2.4	26.7
4	SS II First Term	20	10	6.1	61.0
5	SS II Second Term	20	9	4.2	46.7
6	SS II Third Term	20	10	4.8	48.0
7	SS III First Term	20	5	2.6	52.0

Analysis of Result

The analysis is presented in line with the four research questions that guided the study.

Research question 1: *What is the extent of use of practical activities by teachers in teaching chemistry?*

Table 1 indicates that 37.8% teaching of chemistry experiments in secondary school was done with practical activities; 15.2% demonstration; 29.2% theoretically while in 17.8% cases no class was held. Therefore, it can be inferred that the extent of use of practical activities in teaching chemistry is low.

Research Question 2: *What is the extent of students' involvement in practical activities in chemistry?*

Table II shows that percentage of practical activities performed by the students is 28.9%. Therefore, the extent of students' involvement in practical activities in chemistry is low.

Research Question 3: *What is the extent of coverage of the scheme of work for practical chemistry?*

Tables IIIA and IIIB indicate that the extent of coverage of the scheme of work for practical chemistry is low. This is because summation of percentages for *theoretical approach* and *no class held* gave 51.7% and 47.0% for students and teachers respectively. This implies that the teachers and students agreed that the scheme of works for practical chemistry was partially covered, and this was done theoretically.

Research Question 4: *At what level do students start practical activities in chemistry*?

Tables IVA and IVB show that students start practical activities in chemistry during the first term of SSII. The students and teachers scored 43.5% and 61% respectively on the item indicating the class level at which practical activities commenced. This implies that teachers and students agreed that practical activities in chemistry start in the first term of SSII class.

Discussion

Table 1 shows that *teaching experiment with practical activities, mere demonstration, theoretically and no class held* were scored 37.8%, 15.2%, 29.2% and 17.8% respectively. The scores indicate that the extent of use of practical activities by teachers (37.8%) in teaching chemistry is low. Even when considered relatively moderate, 37.8% is still low. It could be inferred from this result that teachers do not use practical activities sufficiently in teaching chemistry. The present result agrees with Alonge, Jabaru-Aremu and Okorie (1984); and Eze (2009) who found that teachers do not use practical activities adequately in teaching chemistry and this affects students' interest and performance in chemistry.

Table 2 shows that teaching experiment with practical activities, mere demonstration, theoretically and no class held had 28.9%, 19.5%, 40.8% and 10.8% respectively. Based on the data, the extent of students' involvement in practical activities in learning chemistry is low, because the percentage of practical experiments performed by the students is 28.9%. This finding, also agrees with the findings of Alonge et al, (1984) and Eze (2009) who found out that students' involvement in practical chemistry activities is low. Ette (2006) explained students' low involvement in chemistry practical activities. The authors reported that most of secondary school laboratories are ill equipped and consequently students are denied participation and opportunity to verify the reality of the chemical reactions, which only practical activities could afford them.

From the tables IIIA and IIIB above, it can be inferred that the extent of coverage of the chemistry scheme of work is low. This is because the percentages of practical in both students and teachers are low. Most of the practical lessons are done without practical activities. Therefore the chemistry scheme of work is not adequately covered since work covered by theoretical method is not the best way of teaching practical chemistry. This is in agreement with Nwosu (2011) who observed that majority of the currently serving science teachers are not qualified to teach chemistry at senior secondary school level.

Tables (IVA and IVB) above, show relative mean and percentages of the responses of the students and teachers per term. From the table it can be inferred that both the students and teachers had 43.5% and 61% respectively at first term SSII as their highest percentages. This implies that teachers and students agreed that practical activities in chemistry start at SSII first term. A critical look at the tables shows that there is a relative decrease in the number of experiments from SSII (11 items in the first term) to SSIII (5 items in the first term), which signifies that the rate is low. This is in agreement with Eze (2009) assertion that some chemistry students never experienced any form of practical activities until their senior secondary school year three, when they are preparing for their certificate examination.

Conclusion

Practical activities are very fundamental to science, especially chemistry. Investigating the extent of use of practical activities in chemistry would help greatly to remedy the educational gap that is often created in the classroom, when students are not involved in practical activities. It can be concluded from the findings of the present study that:

i) the extent of use of practical activities in teaching chemistry by teachers in senior secondary school is low;

ii) the extent of students' involvement in the use of practical activities in the study of chemistry in secondary is very minimal;

iii) teachers use more of theoretical method in teaching chemistry; and

iv) students start chemistry practical activities late and at low rate.

Recommendations

Based on the above findings, the following recommendations are made.

1. Seminars, workshops and conferences should be organised for teachers and students, with the aim of emphasising, the need for their serious involvement in practical activities in chemistry lessons. These will help the teachers to keep abreast of current practices and trends in pedagogy. Thus, more interest to study chemistry will be generated in the students.
2. School proprietors, especially Government at various levels should provide well-equipped laboratories for the students' use in all the secondary schools.
3. More teachers that are qualified should be employed and encouraged to remain in the school system, since they are in a better position to use the practical activities to promote students' interest and performance in chemistry.
4. The supervising principals and their team to ensure effective use of practical activities in teaching and learning of chemistry should carry out frequent and effective supervision of schools.
5. Institutions responsible for the training of secondary school chemistry teachers should give the student-teachers proper training on the use of practical activities in teaching and learning of chemistry.

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