Effects Of Hands-On Activity (Laboratory) Based Method on Students' Academic Achievement in Chemistry n Yakurr Local Government Area of Cross River State, Nigeria.

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Abstract- This study examined the effects of handon activity (laboratory) based method students' academic achievement in chemistry. One research question and a corresponding null hypothesis was formulated to guide the study. These was made about the effect of teaching method on students' achievement in chemistry. Literature was reviewed in line with these chosen variables from which research gaps were identified. The design adopted for the study was quasi-experimental design with equivalent intact class as experimental group and control group. Both groups were taught the same chemistry topics but by two different chemistry teachers of approximately equal qualification, experience and pedagogical content knowledge. The students' were pre-tested using a researcher-made 30 item chemistry achievement test (CAT) whose Kuder-Richard (KR-20) reliability coefficient was .792. The teaching was done for six weeks. At the end, the same test was administered as post-test. Two points were for every correct answer and no point for wrong answer, giving a maximum possible scores of 60 points. The data were correlated as total raw scores for analysis. One-way analysis of covariance (ANCOVA) was used to analyze the data while F-ratio test was used to test for significance of teaching method. The results obtained showed that; there is significant effect of teaching method on students' academic achievement in chemistry in favour of students taught chemistry using laboratory practical activity method, in favour of male students taught chemistry using laboratory practical activity method. Based on the results it was recommended among others that chemistry teachers

should always apply laboratory practical activity method when teaching chemistry.

Indexed Terms- Chemistry, Laboratory method, Academic achievement.

I. INTRODUCTION

Science is the bedrock of civilization and development of any nation. Nigeria as one, has made various efforts towards the realization of science, technology and mathematics (STM) educational objectives which include: to serve as a unifying factor for different science subjects (Physics, Biology, Chemistry) by emphasizing the processes of science, and to promote scientific literacy among the learners. Science therefore, is receiving much emphasis in education because of its significance and relevance to life and society at large. As described by Ogunleye (2002), science represents a dynamic human endeavour aimed at understanding the intricacies of the modern world.

Science is the systematic study of the natural world and the laws that govern it Otuo (2010). It involves observation, experimentation, and analysis to gather knowledge and understanding. It encompasses various disciplines such as physics, biology, chemistry, and more. It has revolutionized various fields, such as medicine, communication, transportation etc.

Today in the world, technological advancement is the order of the day which is attainable through a fundamental robust foundation in science and technology education. Achieving this involve fostering learners' interest in science, specifically Chemistry emerging from their secondary school level. That is the reasons, Science Teachers' Association of Nigeria (STAN) and other emerging educational organization, and non-governmental bodies have a proactive contributions toward curriculum innovations in science through exciting initiative such as the Nigerian Secondary Schools Science Project (NSSSP) with emphasizing on handson activity practice which is a learners-centred, problem-based approaches and critical thinking.

According to Akpan (2016), chemistry is the study of matter and the changes that matter undergoes. It is a branch of science which deals with the study of the nature, composition and properties of matter and the changes matter will undergo under different conditions. Chemistry is an experimental science subject whose study involves exploration of relationship between theory and experiment (Otor, 2013). The study of chemistry as a subject at the secondary school level helps students in developing basic science skills, knowledge and attitude-based competencies required for problem solving in their environment. Therefore, a poor foundation in chemistry at the secondary school level may jeopardize future achievement in the subject (Pajares & Johnson, 2016).

Among the major variables that measure a learner's success or failure in chemistry is academic achievement. Academic achievement is often cognitive based and measured by examination or continuous assessment. According to Usman and Memeh (2012), the factors that negatively affect chemistry achievement include inadequate laboratories and equipment, inadequate instructional materials and poor adoption of teaching methods among others.

Different scholars in their research findings: such as Green (2024) indicated that laboratory activity approach, which involve the processes of science, can be effective in enhancing students' academic achievement in science. According to Muleta (2016), laboratory activity method gives the learner opportunity to investigate information via experimental procedures. These procedures need careful observations and interpretation of data. It has the characteristics of questioning, investigating and confronting the unknown. While the exercise approach is a regular activity which tests predetermined answers to know the ability or skill of the students, the desirable experiments are exercises, arranged as logical thought and intellectual action rather than performance.

Engaging the learners' in activity based process provide a valuable opportunity to explore abstract concepts and generalizations using laboratory practical activity method. Through interactions with learning materials, teachers, and learners, and by practising scientific methodologies, learners gradually develop the necessary skills needed for engagement in science. Hence, chemistry learning should geared towards investigative activities.

It is on the premises that laboratory practical as component of chemistry teaching cannot be over emphasized, little wonder why Tairab (2014) opined that practical work has helped students in knowledge acquisition. Daramola (2013) and Ogunniyi (2017) advocated that science (chemistry) taught in schools, should be technologically secondary oriented, which means to teach science (chemistry) with its practical application which strengthens the fact that in recent times, science teaching has taken a new trend. Chemistry belonged to the laboratory as cooking belongs to the kitchen and gardening to a garden. This is the state where science teaching is best done in the laboratories. Ndu (2010) emphasized the need for practical teaching of all science subjects and hence argued that meaningful learning of science cannot be achieved without knowledge of practical aspects.

Fensham and Bellocchi (2012), examined effect of practical activity method on Students' academic achievement in Biology amongst secondary school students in Delta State Nigeria. The participants were 302 (136 males and 166 females) SSII students drawn from the 252 public secondary schools across the education zones in Delta state. The study adopted the correlational research design which is capable of predicting the relationships between dependent and independent variables in a study. The instruments used to collected relevant data from the students were

Biology Interest Scale (BIS) and terminal continuous assessment results. The instruments were subjected to validity and reliability and found to be reliable at Cronbach Alpha coefficient of .89. Hierarchical regression technique was used for data analysis. The findings showed that students practice predicts about 57% of academic achievement scores of secondary school students in Biology. The study thus concluded by recommending that students with an improved practice in Biology science are expected to gain higher academic achievement in Bioloy.

Another study by Olaninypmi (2014). Examined the effect of practical activities on students' academic achievement and attitude towards Mathematics. Quasi-experimental design under quantitative method was adopted in the study, with five research questions and two hypotheses. The sample of 242 Mathematics students' SS II was used. The instrument was the Interest and Sustenance in Mathematics Questionnaires (ISMQ), divided into sections A and B. Mean and standard deviation were used to answer the research questions while the hypotheses were analyzed using Pearson Product Moment Correlation Coefficient before conversion to t-test for test of significance. From the analysis, it was found that there is a significant relationship between interest in chemistry and the method of teaching in the subject. It was recommended that Mathematics teachers should use all available practical activity method to arouse students' interest and sustain it so as to enhance academic achievement

Etukudo (2014). Investigated the effect of practical activity teaching method on academic achievement of senior secondary Physics students in Uyo Education Zone, Akwa State. Two research questions and two hypotheses were formulated to guide the study. The population of the study was 5,331senior secondary schools Biology students in Uyo Education Zone. A sample for the study was 125 drawn from Senior Secondary two (SS II) students, which were randomly selected through purposive sampling technique. The design was quasi-experimental research which involved pre-test, post-test control groups. The instrument used for data collection was 40 items Physics Achievement Test (BAT) adopted from WAEC past question papers. The instrument was subjected to face and content validity by two experts. The reliability of the instrument was obtained using the Pearson Product Moment Correlation Coefficient and the obtained r-value was 0.61. Mean and standard deviation were used to answer research questions. Analysis of Covariance (ANCOVA) was used for hypotheses testing at 0.05 level of significance using Statistical Package for Social Science (SPSS). The findings show that there was significant effect of practical activity method and on students' academic achievement in Physics. Students who were taught Physics with practical activity method performed better than their counterparts taught with conventional method.

Afyusisye and Gakuba (2022) research on improving Chemistry education in Senior Secondary Schools through the use of laboratory experiment in Oyo State. Sample of 160 Chemistry teachers from 115 Secondary Schools was used out of 294 using the following instruments; Chemistry Laboratory Resources Assessment Checklist (CLRAC) and Chemistry Teachers Level of Utilization of Laboratory Resources Questionnaire (CTLULRQ). The study adopted ex-post-facto research design. The study found out that laboratory resources were inadequately provided in schools and there was a significant mean difference in the provision of Chemistry Laboratory Resources. The result further showed that direct effect of inadequate laboratory usage was responsible for 0.97% of the total effect of teaching Chemistry in the study area on student's achievement in Chemistry while, its indirect effect accounted for 3.37% of the total effect.

Hodson (2012) in his own work, classified the reasons given by teachers for engaging in practical work into five major categories namely to motivate learners by stimulating interest and enjoyment, teaching laboratory skills, to enhance learning of scientific knowledge, give insight into scientific methods and develop certain scientific methods, this coincides with the classification of practical work reported by Gott, Welford, and Foulds (2018) when they identified five types of practical works like, inquiry practical, investigative practical, skill practical, illustrative practical and observational practical. Although, (Abimbola & Dada 2015) stated that some practical scientific experiences may be acquired in everyday life, the most important part of the experiences is through practical work which gives the students the appreciation of the spirit of science. Therefore, there is no adequate substitute for retention of facts and which also makes learning more permanent because, practical work closely linked with theoretical work help to maximize opportunity to practice those scientific methods. Laboratory practical activities in chemistry provide opportunities for students to actually do science as opposed to learning about science.

Nzewi (2018) asserted that laboratory practical activities can be regarded as a strategy that could be adopted to make the task of teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters. He maintained that practical activities should engage students in hands-on, mind-on activities, using varieties of instructional materials/equipment to drive the lesson home.

Nwagbo (2014) stated that: The use of practical activities (approach) to the teaching of biological concepts should therefore be a rule rather than an option to chemistry teachers, if we hope to produce students that would be able to acquire the necessary knowledge, skills and competence needed to meet the scientific and technological demands of the nation. The search for a more effective approach for the teaching and learning of chemistry that will enhance the acquisition of science process skills has persisted over the years. This is because, the acquisitions of science process skills are the bases for scientific inquiry and the development of intellectual skills and attitudes that are needed to learn concept.

It is obvious from the related literature reviewed that the effect of hands-on activity (laboratory) based practical activity method on students' academic achievement in chemistry is important. This therefore leads to investigation of effects of hands-on activity (laboratory) practical based method on students' academic achievement in chemistry in Yakurr LGA, of Cross River State, Nigeria.

II. PURPOSE OF THE STUDY

The purpose of this study seeks to investigate effect of hands-on activity (laboratory) based method on students' academic achievement in chemistry in Yakurr local government area of Cross River State, Nigeria. Specifically, the study sought to find out whether:

1.Laboratory practical activities affect the academic achievement of students' in chemistry.

III. RESEARCH QUESTION

The following research question guided the study:

1. What are the mean achievement scores of chemistry students taught chemistry using laboratory practical activity method and those taught with lecture method?

IV.RESEARCH HYPOTHESISOne research hypothesis guided this study:

1. There is no significant difference between the mean achievement scores of students taught chemistry using laboratory practical activity method and those taught using lecture method.

V. METHODOLOGY

This study adopted quasi-experimental research design, involving a pre-test and post-test. The design was suitable for the study because intact classes were used and were randomly assigned to both experimental group and control group. Intact classes were used because of the duration of the study and it was not proper to alter normal classes. The design is represented as follows;

$$EG - O1 - X1 - O2, CG - O1 - XO - O2$$

Where; EG - Experimental Group, CG - Control Group, O1- Pre-test

O2 - Post- test, XO - No treatment, X1 - Treatment

The population of the study consists of two thousand six hundred and forty seven (2,647) senior secondary (SSII) chemistry students selected from all the 17 secondary schools in public Yakurr Local Government Area of Cross River State (Head of Department of Planning, Research and Statistics of Cross River State Education Board, 2024). SSII classes were used for the study because this is the class among which chemistry is offered as a subject. The researcher decided to use the SSII students since at that level of class, students were already exposed to chemistry contents or topics that required both experimental and theoretical studies and can also contribute to the research at hand, and expose to the rudiments of experimental research design. The simple random sampling technique was used to select five (5) public secondary schools with the sample size of two hundred and fifty (250) senior secondary school two students in Yakurr LGA for the study. Out of this five schools, three schools were assigned to the experimental group while the remaining two schools were assigned to the control group using simple random sampling technique by balloting. Similarly, out of the two hundred and fifty (250) students, one hundred (100) were male students while one hundred and fifty (150) were female students. One hundred and twenty-nine (129) male and female students were taught chemistry by both male and female teachers in three (3) schools (Aviga Community Secondary School, Okodung, Community Secondary School, Ekori and Community Secondary School, Agoi Ibami) and out of the remaining one hundred and twenty-one students, sixty (64) students were taught chemistry by a male teacher separately in Girls' Secondary School, Ugep while fifty-seven (57) students were taught chemistry by a female in Tekowa Comprehensive Secondary School, Agoi Ekpo respectively.

The instrument used for data collection in this study was Chemistry Achievement Test (CAT) developed

by the researcher. It's contained 30 multiple choice items with option A-D to fulfil the purpose of the study. The instrument contained two sections: A and B. Section A contained demographic information of the respondents while Section B contained items on the CAT questions. CAT was administered to both students in their respective schools as pre-test at the beginning with the research assistants. The scores of the students on the pre-test were recorded and kept at the end of the pre-test. The same instrument was administered to the students at the end of the experimental period. Both the scores obtained from pre-test and post-test were subjected to both inferential and descriptive statistical analysis. Mean and standard deviation were used to answer to the research question while the analysis of Co-variances (ANCOVA) was used to test the null hypothesis at 0.05 level of significance.

VI. RESULTS

In this section of the study, the result of data analysis were presented based on the research question and the hypothesis that guided the study.

VII. RESEARCH QUESTION

What are the mean achievement scores of chemistry students taught chemistry using laboratory practical activity method and those taught with lecture method? The mean scores of all male and female students involved in the study in the five schools for pre-test and post-test were used to answer the research question. Summary of results of data analysis were presented in table 1.

Table 1
Descriptive statistic of mean scores of male and female students taught chemistry

Grouping	Study	Study	Ν	Mean	Std.	Std.	Mini.	Max.
variable	variable	Group			Dev.	Error		
Gender	Pre-test	Male	112	31.23	4.45	.42	23	41
		Female	138	30.97	4.81	.41	21	41
		Total	250	31.09	4.65	.29	21	41

Post-test	Male	112	36.29	5.16	.49	25	47
	Female	138	37.62	4.69	.40	26	48
	Total	250	37.02	4.94	.31	25	48
Gain score	Male	112	5.05	5.88	.56	-10	17
	Female	138	6.65	4.67	.39	-3	20
	Total	250	5.94	5.29	.34	-10	20

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The results of data analysis presented in table 1 above in pre-test revealed that gender seemed to have differential effect on female students. This is because female students had a mean score of 30.97 and a standard deviation score of 4.81 while the male students had a mean score of 3.23 and a standard deviation score of 4.45. At post-test, female students had a mean score of 37.62 and a standard deviation of 4.69 while the male students had a mean score of 36.29 and a standard deviation of 5.16. In terms of gained scores, the female students has a mean score

of 6.65 and a standard deviation score of 4.67 while the male students had a mean score of 5.05 and a standard deviation of score of 5.88. This implies that female students performed better than the male students in chemistry in the classroom interaction.

Testing of null hypothesis

 H_{01} : There is no significant difference between the mean achievement scores of students taught chemistry using laboratory practical activity method and those taught using lecture method.

Table 2
One-way ANCOVA of Students' Chemistry Achievement by
Tasshing Mathad

Teaching method	Ν	Mean	Std. Dev.	Std. Error	Adjusted			
					Mean	Error		
Practical activity	140	39.39	4.16	.35	39.45	.31		
Lecture	110	34.02	4.17	.39	33.94	.38		
Total	250	37.02	4.94	.31	36.69	.23		
Source of variation	Sum of squares	Df	Mean sq.	F-value	P-value			
Corrected	2794.87	2	1397.43	105.33	.00			
Model	2902.89	1	2902.89	218.80	.00			
Intercept	1020.15	1	1020.16	76.89	.00			
Pre-test	1868.78	1	1868.78	140.86	.00			
Method	3276.10	247	13.27					
Error								
Total	348766.00	250						
Corrected Total	6071.86	249						

R² = .46 Adj R² = .46 Significant at .05 level Covariates evaluated at Pre-test = 31.09

The results in Table 4 showed that at post-test, the mean score of students taught using lecture method (x = 34.02) was less than that of student taught using practical activity method (x = 34.39). The P-value (.00) associated with the computed F-values (105.33, 218.80, 76.89 and 140.86) for corrected model,

intercept, pre-test and teaching method respectively, were less than. Thus, the null hypothesis was rejected. This means that there is a significant difference between the mean achievement scores of

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students taught using laboratory practical activity method and those taught using lecture method. The mean post-test scores were adjusted for the influence of the pre-test achievement at pre-test = 31.09. The results showed difference in the adjusted means in favour of the experimental group (39.45 and 33.94).

VIII. DISCUSSION OF FINDINGS

Teaching method (laboratory practical activity method) and students' achievement

The results here showed that teaching method has significant effect on students' achievement in chemistry in favour of laboratory practical activity method, when compared to lecture method. These results were expected due to the fact that, a laboratory helps students to discover what they do not know yet and confirm the truth of the knowledge acquired in the classroom. The availability of laboratory facilities in schools enhances the effectiveness of the educational process, increase the productivity and efficiency of teaching, and increase the acquisition of basic knowledge and skills for economic and educational development. This arise from the fact that in the laboratory activity method of the sense organs of sight, touch, hearing, perception, taste and affection are involved, thus making teaching most effective. On the other hand, the lecture method relies on hearing and perception alone and so cannot be expected to be as effective as laboratory activity method. The emphasis in lecture method is purely on remembering and reproduction of facts and principles. The learner is passive while the moderates and regulates the flow of information and knowledge.

The results agree with the position taken by authorities like Muleta (2016), Eliubon (2016), Olaninypmi (2014), Etukudo (2014), Omiko (2015), Dike (2020) and a host of others. All these authorities hold the opinion that any teaching method that involves the utilization of the gateways to knowledge, cognition, affection and psychomotor will be effective, when compared to the one that utilizes only one, like lecture method that uses only the cognitive domain of knowledge.

The implications of these results are many and varied but one-dimensional. Any method that combines practical activities with theory, particularly in the sciences and mathematics will be effect. It implies that schools as well as government who desire improved results in the sciences and chemistry should seriously consider investing in the building, procurement and utilization of laboratory and its facilities to enhance students' academic achievement in science generally and chemistry in particular.

CONCLUSION

The findings of the study revealed that teaching method has significant effect on students' academic achievement in chemistry in favour of laboratory practical activity method. It is the opinion of the researcher if educational stakeholders can pay attention to the suggestions made: the problem of differences encountered in students' academic achievement in schools will reduce to the bearable rate.

RECOMMENDATION

Based on these findings, the researcher recommended that:

- 1. Chemistry teachers should always apply laboratory practical activity method when teaching chemistry.
- 2. Government and non-governmental organizations should support schools with well-equipped science laboratories to enhance science teaching.

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