Effect of Laboratory Activity Teaching Method on Students' Interest and Academic Achievement in Chemistry in Ikom Education Zone, Cross River State, Nigeria.

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ABSTRACT

This study examined the effect of the laboratory activity teaching method on students' interest and academic achievement in Chemistry. A quasi-experimental design with a pre-test–post-test control group setup was employed. The study involved 314 Senior Secondary School One (SSI) chemistry students from eight co-educational schools in the Ikom Education Zone, Cross River State, Nigeria, selected purposively. The data collection instruments were the Chemistry Interest Inventory Scale (CIIS) and the Chemistry Achievement Test (CAT), which demonstrated reliability coefficients of 0.78 and 0.85, respectively, through the test–retest technique. Data were analyzed using Analysis of Covariance (ANCOVA).

The results revealed a significant difference in the mean interest scores of students taught chemistry using the laboratory activity method compared to those taught using the conventional method, with the laboratory activity method proving more effective. Furthermore, students in the laboratory activity method group outperformed their counterparts in the conventional method group. Based on these findings, it was recommended that government and non-governmental organizations provide well-equipped and functional laboratories to facilitate the effective implementation of the laboratory activity method in the teaching and learning of science (chemistry), thereby enhancing students’ interest and academic achievement.

Keywords: Chemistry, Effect, Laboratory method, conventional method and Academic achievement.

INTRODUCTION

Science and technology have proven to be significantly useful in humanity’s daily struggle to explore the environment for meaningful living. Globally, countries—especially developing ones—have continually sought to improve the quality of science and technology education. The role of science and technology in the sustainable development of every nation can hardly be overemphasized. Science surrounds us and is practiced daily. It may be viewed as a way of thinking in pursuit of understanding nature, a method of investigation, and a body of established knowledge (Buhatwa, 2014).

Science is both a process (the scientific method) and a product (knowledge, facts, and principles). Both aspects are acquired through education, in a specialized form known as Science Education. All branches of science contribute significantly to a nation’s technological advancement. However, science has been organized into specific subject areas taught at the senior secondary school level as Biology, Chemistry, and Physics.

Chemistry education focuses on the teaching and learning of chemistry, encompassing both subject content and effective pedagogical strategies. It prepares individuals to become competent chemistry educators at different levels, from secondary to tertiary education. A solid foundation in core chemistry concepts, combined with pedagogical knowledge, is crucial for success in this field.

Chemistry deals with the structure, characteristics, and composition of matter, the changes matter undergoes, and the energy involved in such transformations (Ababio, 2016). The teaching and learning of chemistry help students acquire scientific skills such as handling laboratory apparatus and conducting experiments with confidence.

Chemistry is also embedded in everyday life. Beyond the school environment, chemical activities are evident in the kitchen, industries, and the environment. Among the branches of science, chemistry occupies a central role as a prerequisite for professional courses such as Medicine, Forestry, Agriculture, Biotechnology, Biochemistry, and Nursing. Studying Chemistry in senior secondary school equips students with useful skills that enable them to face challenges both during and after graduation.

According to Curry, Pesout, and Pigford (2020), the importance of chemistry includes:

- Understanding the nutritional value of food and the chemical reactions involved in cooking.
- Preserving food through processes such as canning and refrigeration.
- Making informed choices about healthier foods.
- Avoiding foods and drinks with harmful chemical effects.
- Using medications to relieve pain.
- Applying antiseptics to prevent infections.
- Manufacturing dyes and synthetic fibers for clothing.
- Preparing insecticides and pest repellents, among others.

Studying chemistry also helps in making informed decisions regarding the use of chemical substances in daily life. Professionally, it provides training to apply scientific knowledge in solving health, environmental, and industrial problems involving chemical processes and reactions.

Ezike (2018) defines interest as a feeling or emotion that directs attention to an object, event, or process. Students' interest refers to their inclination toward a specific subject with which they can easily connect. Such interest is influenced by teaching methods, producing either positive or negative effects.

Interest in chemistry has been identified as a key factor in the declining number of students choosing science subjects at senior secondary school (Lee, Lee, & Bong, 2014). Low interest has been linked to students' anxiety and fear (Okigbo & Okeke, 2018). As one of the most difficult science subjects, the extent to which interest predicts achievement in chemistry is critical for shaping educational policies that aim to boost students' achievement and contribute to national development.

Academic achievement is the extent to which a student, teacher, or institution attains short- or long-term educational goals. It may be described as successful performance in a subject area, often measured by skills, effort, test scores, or evaluative feedback (Uluk, 2019).

Despite the importance of chemistry as a prerequisite for many tertiary courses and as a tool for national development, students' achievement in the subject remains poor. Reports from the West African Examination Council (2019–2023) in Cross River State indicate that more candidates failed chemistry than those who passed at credit level. This poor performance has been attributed to factors such as unfamiliarity with laboratory equipment, limited exposure to practical work, poor observational skills, and difficulty in carrying out simple calculations.

Among the factors contributing to students' low interest and poor achievement in chemistry, Fadzil and Saat (2017) identified inappropriate teaching methods as a major cause. Teacher-centered instruction dominates, often neglecting students' active participation and making them passive recipients of knowledge. Cheung (2018) stressed that to make chemistry learning more meaningful and student-centered, teachers must adopt innovative strategies. One such approach is the **Practical Activity Teaching Method**, which encourages active student participation.

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Conventional methods of teaching, commonly used by chemistry teachers, rarely provide opportunities for active learning. Practical activities remain central to scientific study since science is both a product and a process. The availability of laboratories in secondary schools is essential for providing the best practical experiences that foster skill acquisition. Practical activities not only promote knowledge acquisition (Ntawuhiganayo & Nsanganwimana, 2022) but also help students develop problem-solving and creative skills (Daramola, 2018; Nghambi, 2014).

Similarly, Lawal (2013) and Omiko (2015) emphasized that engaging students in practical activities is crucial for academic success in science subjects such as Biology, Chemistry, Physics, and Mathematics. Buba and Marcel (2019) also argued that practical teaching of science enhances students' academic achievement in Nigerian secondary schools.

Dike, Andersson, and Enghang (2017) confirmed that laboratory-based practical investigations provide opportunities for students to acquire core scientific skills, including observation, classification, hypothesizing, prediction, measurement, and experimentation.

By contrast, the conventional method of teaching relies heavily on textbooks, teacher dominance, and exam-oriented approaches, emphasizing rote memorization of facts and principles rather than critical thinking (Shuchi, 2018; Ayodele, Obafemi & Ebong, 2015). In this method, students are passive, and learning is extended mainly through homework and assignments (Uzezi & Deya, 2017). An example of this approach is the lecture method.

Hinneh (2017) noted that the continued use of inappropriate instructional methods by secondary school chemistry teachers raises concerns among researchers, as it is a major factor contributing to students' poor achievement in science, particularly chemistry.

Given these challenges, researchers have conducted empirical studies to investigate the relevance of laboratory practical teaching methods on students' interest and achievement in chemistry.

Purpose of the Study

The main purpose of this study was to investigate the effect of the laboratory activity teaching method on students' interest and academic achievement in Chemistry in Senior Secondary Schools in Ikom Education Zone, Cross River State, Nigeria.

Specifically, the study sought to investigate:

- The effect of the practical activity teaching method on students' interest in Chemistry.

Research Questions

One research question guided the study:

- What is the effect of the teaching method on students' mean interest scores in Chemistry?

Null Hypothesis

One null hypothesis was formulated to guide the study:

- There is no significant effect of the teaching method on students' mean interest scores in Chemistry.

METHODOLOGY

This study adopted a quasi-experimental research design, involving both a pre-test and a post-test. This design was selected to assess respondents' behaviours before and after the intervention. It involved two groups (the practical activity method and the conventional method).

The design was considered suitable because intact classes were used and randomly assigned to both the experimental and control groups. Intact classes were used due to the limited duration of the study, and it was not appropriate to alter normal classroom arrangements.

The quasi-experimental design was preferred because it allows for the manipulation of more than one variable. It also permits the assessment of the effect of the independent variables separately, as well as their interactive effects. Both the experimental and control groups were given a pre-test and a post-test.

The design is symbolically represented as follows:

Y1 EG O1-------X1-------O2 03

Y2 CG O1-------X2-------O2 03

EG - Experimental Group represent group taught using practical activity teaching method,

CG - Control Group represent group taught using conventional method

X1 = Treatment for experimental group (Group taught with practical activity method)

X2 = Control group (Group to be taught with conventional method)

O1 = Pretest observation for experimental and control groups

O2= Post-test observation for experimental and Control groups

O3= Interest rating for experimental and control groups

Y= Moderator variables (gender and location)

The population of this study comprised three thousand seven hundred and sixty-seven (3,767) Senior Secondary One (SSI) chemistry students drawn from all 108 public secondary schools in the Ikom Education Zone of Cross River State during the 2022/2023 academic session.

The researcher selected SSI students because, at this level, they had already been introduced to chemistry content and practical activities. The students were therefore able to respond effectively to the items in the instruments administered. Introducing a practical activity-based teaching method was expected to stimulate students' interest in chemistry and improve their academic achievement.

A multi-stage sampling procedure involving stratified, purposive, and simple random sampling techniques was used to select eight (8) schools, yielding a sample size of three hundred and fourteen (314) SSI chemistry students across eight intact classes within the study area. Of this sample, 160 were male and 154 were female. A total of 164 students were assigned to the experimental group, which was taught using the practical activity teaching method, while 150 students were assigned to the control group, which was taught using the conventional expository method.

The data collection instruments included the Chemistry Interest Inventory Scale (CIIS) and the Chemistry Achievement Test (CAT), both developed by the researcher to assess students' interest and achievement in chemistry. The CIIS consisted of 30 interest-based items, while the CAT contained 50 multiple-choice questions covering the SSI chemistry curriculum. The topics addressed in the CAT focused on five separation techniques: distillation, chromatography, evaporation, sieving, and filtration. The CAT was administered as both a pre-test and a post-test.

The instruments were subjected to face and content validation by two experts—one in Science Education and the other in Measurement and Evaluation—from the University of Cross River State, Calabar. They assessed the appropriateness of the items in measuring the intended constructs and the correctness of the questions. Based on their feedback, the instruments were revised and refined to meet face and content validity requirements.

To establish reliability, a test–retest method was employed. A trial test was conducted on forty (40) non-participating SSI chemistry students from Government Secondary School Ayeabam, Akamkpa, Cross River State, who had studied standard separation techniques. The CIIS yielded a reliability coefficient of 0.78 using Cronbach's Alpha, while the CAT yielded a reliability coefficient of 0.85 using the Kuder–Richardson Formula 20 (KR-20).

Data collection took place in three phases: the pre-test (one week), treatment (five weeks), and the post-test (final week). During the treatment phase, three 40-minute lessons per week were conducted, following the schools' chemistry timetable without alterations. In the experimental group, practical activities immediately followed the theoretical lessons, enabling students to apply their newly acquired knowledge. In contrast, the control group was taught exclusively through the conventional expository method. The CAT was scored out of 100%.

Data obtained from the administration of the instruments were analyzed using Analysis of Covariance (ANCOVA), and the hypotheses were tested at a significance level of $p < 0.05$.

RESULTS

This section presents the results of data analysis based on the research questions and hypotheses that guided the study.

Descriptive Statistics of Study Variables

The descriptive statistics (mean, standard deviation, standard error, minimum, and maximum) of students' achievement in chemistry were computed at the pre-test and post-test stages, disaggregated by gender. The results are presented in Table 1.

Table 1 Descriptive Statistics of Study Variables by Student's Gender

Name of variable	Students gender	N	Mean	Standard deviation	Standard error	Minimum	Maximum
Chemistry pre-test	Male	159	19.45	5.91	1.47	8	44
	Female	155	14.97	5.30	.43	4	32
	Total	314	17.24	6.04	.34	4	44
Chemistry post-test	Male	159	47.71	17.13	1.36	20	90
	Female	155	38.71	13.57	1.09	14	80
	Total	341	44.23	16.40	.93	14	90
Chemistry Interest Pre-test	Male	159	23.42	10.74	.85	6	80
	Female	155	18.35	7.13	.57	4	49
	Total	314	20.91	9.47	.53	4	80
Chemistry InteresPost-test	Male	159	46.51	20.63	1.64	15	89
	Female	155	36.67	15.80	1.27	7	83
	Total	314	41.66	19.03	1.07	7	89

The results in Table 1 showed that, at the pre-test stage, the mean score for chemistry achievement of males (19.45) was higher than that of females (14.97). At the post-test stage, the same pattern was observed. For chemistry interest, the mean score at the pre-test (17.24) was lower than the mean score at the post-test (44.28). A similar pattern was also observed for chemistry interest.

Table 2 Descriptive Statistics of Study Variables by Teaching Method

Name of variables	Teaching method	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Chemistry Interest	Lab. Activity	164	24.01	10.47	.82	5	80
	Conventional	150	17.53	6.8	.56	4	30
	Total	314	20.91	9.47	.53	4	80
Pre-test Chemistry	Lab. Activity	164	54.02	17.35	1.36	18	89
Interest Post-test CAT	Conventional	150	28.13	8.87	.724	7	49
	Total	314	41.65	19.03	1.07	7	89
Pre-test CAT	Lab. Activity	164	18.79	6.94	.54	4	44
	Conventional	150	15.53	4.29	.35	4	28
	Total	314	17.24	6.04	.34	4	44
Post-test	Lab. Activity	164	54.45	15.69	1.23	22	90
	Conventional	150	33.16	7.57	.618	14	46
	Total	314	44.28	16.4	.925	14	90

The results in Table 2 show that, at the pre-test stage, the mean score in chemistry achievement for students taught using the laboratory activity method (x = 18.79) was higher than that of students taught using the conventional lecture method (x = 15.53). This pattern was maintained at the post-test stage. A similar trend was observed for chemistry interest at both the pre-test and post-test stages.

These differences were not tested for significance because such tests fall outside the scope of this study. However, a preliminary validation analysis was conducted to examine the influence of students' pre-experiment chemistry knowledge and interest on their post-treatment chemistry achievement and interest. The results showed significant influences (F = 98.14, p = .00 for chemistry achievement; F = 103.67, p = .00 for chemistry interest). These findings justified the use of ANCOVA and the adjustment of post-test scores.

Hypothesis

H01: There is no significant effect of teaching methods on students' mean interest scores in chemistry.

To test this hypothesis, ANCOVA was applied, with teaching method as the factor, post-test chemistry interest as the dependent variable, and pre-test chemistry interest as the covariate. The results are presented in Table 3.

Table 3 One-way ANCOVA of Students' Chemistry Interest by Teaching Method.

Teaching method	**N**	**Mean**	**Std. Dev.**	**N**	**Adjusted**	
					Mean	**Error**
Laboratory activity	164	54.02	17.35	164	51.07	.89
Lecture	150	28.13	8.87	150	31.36	.94
Total	314	41.65	19.03	314	41.21	.63
Source of variation	**Sum of squares**	**Df**	**Mean sq.**	**F-value**	**P-value**	
Corrected Model	75131.16	2	37565.58	305.74	.00 .00	
Intercept	21885.32	1	21885.32	178.12	.00	
Pre-test	22586.47	1	22586.49	183.83	.00	
Method	26843.14	1	26843.14	218.47	.00	
Error	38211.10	311				
Total	658121.00	314	122.87			
Corrected Total	113343.16	313				

Significant at .05 Level

The results in Table 3 show that the mean chemistry interest score of students taught using the laboratory activity method at post-test was **54.02**, which was higher than that of students taught using the conventional method (**28.13**). The p-values (.00) associated with the computed F-values (305.74, 178.12, 183.83, 4218.47) for the corrected model, intercept, pre-test interest, and teaching method respectively are all less than .05. Hence, the null hypothesis was entirely rejected. This indicates that there is a significant difference between the mean interest scores of students taught chemistry using the laboratory activity method and those taught using the conventional method. The adjusted mean interest score for students taught with the laboratory activity method (**51.07**) was significantly higher than that of students taught using the conventional method.

DISCUSSION OF FINDINGS

Laboratory Activity Teaching Method and Students' Interest in Science

The results of the hypothesis indicate that the mean chemistry interest scores of students taught using the laboratory activity method at post-test were higher than those taught using the conventional method. This implies that there is a significant difference between the mean interest scores of the two groups. This finding corroborates the results of Ezeh (2016), Okafor (2020), and Amadi (2021), whose studies showed that teaching methods influence students' interest in chemistry.

However, the present findings contradict those of Akani (2015) and Ntawuhiganayo & Nsanganwimana (2022), who reported that the laboratory activity teaching method did not arouse students' interest in science (chemistry).

The present study therefore reflects both supportive and opposing positions. It supports the current findings because students in the Ikom Education Zone showed greater interest in learning chemistry concepts when they were given equal opportunities to engage in practical exercises. On the other hand, it differs because students taught through the conventional method may not have had sufficient time to ask questions or engage in practical demonstrations. Furthermore, the mastery of these methods may depend on the teacher’s ability to effectively demonstrate experiments in the laboratory, which can be hindered by irregular use of laboratory equipment. Hence, the most likely conclusion is that regular and well-structured laboratory practical activities are essential for promoting students’ interest in science (chemistry).

CONCLUSION

The findings of this study show that students exposed to the laboratory activity teaching method performed better than those taught using the conventional (lecture) method. Since chemistry is essentially a practical-oriented science subject, adopting this teaching strategy can encourage and enhance both teaching and learning outcomes. By participating in laboratory practical activities, students can develop a deeper understanding of scientific principles by interacting with physical objects, thereby moving beyond the theoretical abstractions of science.

RECOMMENDATIONS

Based on the above findings and conclusion, the following recommendations are made:

1. To increase students’ interest in chemistry, teachers should adopt the laboratory activity teaching method when teaching science students.
2. Government and non-governmental organizations should provide adequate laboratory facilities to make the teaching of chemistry concepts more engaging and interesting.
3. Chemistry teachers should adopt instructional methods that arouse students’ interest in the subject. Laboratory practical activities should be prioritized as a fundamental instructional strategy for teaching chemistry and other related science subjects.

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