

EFFECT OF LABORATORY PRACTICAL ACTIVITIES ON SECONDARY SCHOOL STUDENTS' ATTITUDE TOWARDS CHEMISTRY IN KOGI STATE

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Abstract

This study examined the effect of laboratory practical activities on secondary school students' attitude towards Chemistry in Kogi State. Quasi experimental research design was adopted for the study. The study involved a target population of 11,091 SS II students offering chemistry in Kogi State. The sample consisted of 160 SS II students selected using multistage sampling technique. Two research questions and two null hypotheses were formulated to guide the study. The instrument used for data was a validated Chemistry Attitude Scale (CAS). The reliability coefficient of the CAS was established to be 0.80 using Cronbach-Alpha. Mean and standard deviation was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings of the study showed that there was significant difference between the attitudes mean scores of students taught chemistry using laboratory practical activities and those taught using lecture method, in favour of laboratory practical activities. Furthermore, the findings showed that there was no significant difference between the attitudes mean scores of male and female students' taught chemistry using laboratory practical activities. It was concluded that laboratory practical activities was more effective in enhancing students' attitude towards chemistry. Based on the findings, it was recommended among others that chemistry teachers should therefore be encouraged to prepare laboratory experiment for every topic and use the experiments in chemistry textbooks and workbooks recommended by the Ministry of Education.

Keywords: Laboratory practical activities, Attitude, Chemistry, Gender

Introduction

Science is a dynamic and ever-evolving field that seeks to uncover the fundamental laws and principles governing the physical, chemical and biological phenomena that shape our reality. It is a systematic and empirical approach to understanding the natural world and the universe at large. It is defined as the methodical examination of the physical and natural world via close observation (Achimugu et al. 2023). Science, as a systematic and evidence-based approach to understanding the natural world, plays a pivotal role in the advancement and well-being of human society. The importance of science extends far beyond the confines

of academic institutions and research laboratories, as it permeates every aspect of our daily lives, from the technologies we use to the policies that govern our communities. One of the most fundamental contributions of science to society is its ability to expand our knowledge and understanding of the universe. At the senior secondary level Science is categorized into Chemistry, Biology and Physics as the major science subjects taught at that level of education.

Chemistry being a branch of science was described by Offiah and Samuel (2018), as the study of matter, including its constitution, applications, qualities, and physical and chemical changes. Chemistry is a branch of science subject that deals with the studies of structures, composition, properties and the uses of matter (Achimugu, 2016). Chemistry, often referred to as the central science, plays a crucial role in understanding the world around us. It bridges the gap between physics and biology, providing insights into the composition, structure, properties, and changes of matter. Chemistry helps to ensure continuous availability of students in expected number who take important profession such as medicine, pharmacy, dentistry, food science, agriculture, engineering, science education, among others. As a science subject, chemistry continues to evolve, embracing new technologies and methodologies while addressing contemporary challenges. However, despite the prime position Chemistry occupies in our educational system in Nigeria and the efforts made by researchers, students' performance in Chemistry and Sciences, in general, are still low (Abdulrahman et al. 2020; Achimugu, 2018; Nbina & Avwiri, 2021). Poor performance of students in chemistry prevents many students from taking up science professions; this in turn negatively affect the general development of Nigeria at large. Several factors such as teaching method, availability of teaching resources, qualified teachers and students' attitude influences the academic performance of students in chemistry.

Attitude is the positive or negative feelings that an individual has about objects and ideas (Achimugu et al., 2023). Attitude as defined by Aku et al in Achimugu and Muftawu (2019), is an outward and visible posture of human believes that determines what each individual will see, hear, think and do. Attitude can alter every aspect of a person's life, including their education. Students' attitude determines their interest, ability and willingness to learn. Attitudes towards chemistry involve students' tendency to respond to chemistry based on the views and images they develop as a result of their experiences during learning (Kahveci, 2015).

Regardless of the importance of chemistry education in fostering technological advancements and economic growth, students' negative attitude towards the subject has been a major concern in the education sector. The factors influencing students' attitude towards chemistry remain unclear. Studies have identified that students' negative attitudes towards chemistry may be influenced by their perception of the subject, its complexity, and abstract nature (Federal

Government of Nigeria [FRN], 2014, Afolabi and Afolabi, 2015, Asogwa and Ifeanyieze, (2015). Many students dislike Chemistry because the old traditional teaching methods of chalk and talk are still being utilized by teachers while answering easy problems on the board. Unlike the traditional methods of teaching that are teacher-centered, modern innovative teaching methods such as laboratory practical activities are student-centered. Laboratory work is fundamental for developing students' experimental skills and scientific reasoning Boakye (2021). Lecture-based method have been found to be less effective compared to innovative teaching methods. Okam and Zakari (2016) and Ajanaku (2024) in their studies found that students taught chemistry using laboratory teaching strategy and hands-on activity respectively showed positive attitudes more than the students taught using lecture method. Implying that the teaching methods employed by the teacher to teach a particular concept in chemistry may change the attitude of the students towards the subject after a period. Hence the need to investigate the comparative effectiveness of laboratory practical activities and traditional lecture method on students' attitude towards chemistry.

Purpose of the Study

The general purpose of the study was to examine the effect of laboratory practical activities on secondary school students' attitude towards chemistry. Specifically, the study was designed:

1. Examine the difference between the attitude mean scores of students taught chemistry using practical activities and those taught using lecture method.
2. Find out the difference between attitude mean scores of male and female students taught chemistry using laboratory practical activities.

Research Questions

The following research question guided the study:

1. What is the difference between the attitude mean scores of students taught chemistry using practical activities and those taught using lecture method?
2. What is the difference between attitude mean scores of male and female students taught chemistry using laboratory practical activities?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significant:

H₀₁: There is no significant difference between the attitude mean scores of students taught chemistry using practical activities and those taught using lecture method

H₀₂: There is no significant difference between the attitude mean scores of male and female students taught chemistry using laboratory practical activities

Methodology

The study employed a quasi-experimental design, specifically the pretest-posttest non-equivalent control group design. Pretest was administered to the students to determine their initial ability level. The students were then taught using

laboratory practical activities and lecture teaching methods. After the administration of treatment, a posttest was administered to assess the effect of the teaching methods. The study made use of intact classes which were randomly selected and assigned to both the experimental group (Gp A) or the control group (Gp B) respectively. The design can be illustrated as follows:

Gp A (Experimental Group): $O_1 \rightarrow X_1 \rightarrow O_2$

Gp B (Control Group): $O_1 \rightarrow -X \rightarrow O_2$

Where: O_1 is pre-test, O_2 is post-test, X_1 is treatment for experimental group and -X is control group (no treatment).

The experimental group was taught using laboratory practical activity method while the control group was taught using lecture method. The population of this study comprised of 11,091 senior secondary two (SS2) chemistry students of the 257 public senior secondary schools in Kogi State. The sample size was 160 SSII chemistry students. The study adopted a multi-stage sampling technique to select schools from the population. Firstly, simple random technique by balloting was used to select two Local Government Areas from each of the three senatorial zones of Kogi state making a total of six local government areas. Secondly, purposive sampling technique was used to select three public secondary schools each from the six local government area selected for the study making a total of 6 schools for each of the senatorial zone and a grand total of 18 schools. Thirdly, simple random sampling technique by lucky dip was used to select two schools from each of the senatorial zone giving a total of 6 schools from the 18 schools. Fourthly, simple random sampling technique by tossing of coin was used to select 4 schools from the 6 schools. Finally, simple random sampling technique by lucky dip was used to assign two schools with their intact classes to the experimental and the control groups respectively

The study's instrument was the Chemistry Attitude Scale (CAS). The CAS consists of two sections, A and B. Section A contains the demographic data of the respondents, while Section B contains 25 test items which has four point modified Likert-type response scale. The scale was used by the researcher to ascertain students' attitude towards chemistry. Students were expected to indicate their degree of agreement or disagreement with regards to their attitude towards chemistry by ticking the appropriate column. The responses of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD) were respectively assigned value points of (4, 3, 2, 1) for positive items and (1, 2, 3, 4) for negative items. The researcher conducted both face and content validity checks. Two experts in educational measurement and evaluation and one expert in science education validated the instrument. The reliability coefficient of the CAS was established to be 0.80 using Cronbach-Alpha. Regular chemistry teachers (research assistants)

were trained for three days by the researcher on effective implementation of laboratory practical activities and lecture teaching methods in teaching the topic “Acid-base reaction” and appropriate administration of the CAS instrument. The treatment proper lasted for six weeks. First week for administration of pretest, the next four weeks for the treatment proper and the sixth week for administration of posttest. Mean and standard deviation was used to answer the three research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance.

Results

Research Question One: What is the difference between the attitude mean scores of students taught chemistry using practical activities and those taught using lecture method?

Table 1: Attitude Mean Scores of Students Taught Chemistry Using Practical Activities and Those Taught Using Lecture Method

Methods	N	Pretest		Posttest		Mean gain
		\bar{X}	SD	\bar{X}	SD	
Lab. practical activities	92	2.350	0.290	3.980	0.410	1.630
lecture method	68	2.400	0.260	3.000	0.380	0.760

Result in Table 1 showed that students taught Chemistry using laboratory practical activities had attitude mean score of 2.350 at the pretest and mean attitude score of 3.980 at the posttest level while the mean gain score was 1.630. Furthermore, the students taught Chemistry using conventional lecture method had a pretest attitude mean score of 2.400 and posttest attitude mean score of 3.00, with mean gain of 0.760 and mean difference of 0.870. To verify whether the difference between the two means in the post test of the experimental and control groups are statistically significant, ANCOVA was used to test hypothesis one and table 4 showed the result.

Research Question Two: What is the difference between attitude mean scores of male and female students taught chemistry using laboratory practical activities?

Table 2: Attitude Mean Scores of Male and Female Students Taught Chemistry Using Laboratory Practical Activities

Gender	N	Pretest		Posttest		Mean Gain
		\bar{X}	SD	\bar{X}	SD	
Male	48	2.580	0.25	3.980	0.31	1.400
Female	44	2.590	0.20	3.960	0.30	1.370

Result in Table 2 shows the result of the attitude mean scores of male and female students' taught Chemistry using laboratory practical activities. Result revealed that the male students had pretest attitude mean score of 2.580 and a posttest attitude mean score of 3.980, while the female students had a pretest attitude mean score of 2.590 and a posttest attitude mean score 3.960. Result showed that the male students slightly performed higher than their female counterparts with a mean gain of 1.40 while the female students had mean gain of 1.370 resulting to a mean difference of 0.03 in favour of the male counterpart. To verify whether the difference between the two means in the post test of the two groups are statistically significant, ANCOVA was used to test hypothesis one and table 5 showed the result.

H₀: There is no significant difference between the attitude mean scores of students taught chemistry using practical activities and those taught using lecture method

Table 3: Analysis of Covariance (ANCOVA) of Difference between the Attitude mean scores of Students in Chemistry When Exposed to Practical Activities and Lecture Method

Source	Type Sum Squares	III Df of	Mean Square	F	Sig.	Partial Squared	Eta	Decision
Corrected Model	7242.011 ^a	2	4121.005	104.676	.003	.380		
Intercept	8412.684	1	7412.684	188.286	.020	.356		
Pretest Attitude	439.391	1	439.391	11.161	.001	.032		
Methods	6547.785	1	7547.785	121.717	.002	.350		S
Error	13424.940	155	39.369					
Total	899623.000	160						
Corrected Total	21666.951	159						

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result in Table 4 shows the ANCOVA of the difference between the attitudes mean scores of students in chemistry when exposed to laboratory practical activities

and conventional lecture method. The result was statistically significant at (F) = 121.717. Since the associated probability value of 0.02 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that there was a statistically significant difference between the attitudes mean scores of students in chemistry when exposed to laboratory practical activities and lecture method in favour of laboratory practical activities with high mean. The result further showed the effect size ($\eta^2_p = 0.350$), which indicates that thirty five percent (35%) variance in the attitude mean scores of students in chemistry can be attributed to the use of laboratory practical activities method.

H02: There is no significant difference between the attitude mean scores of male and female students taught chemistry using laboratory practical activities

Table 4: Analysis of Covariance (ANCOVA) of the Mean Difference between the Attitude mean scores of Male and Female Students Taught Chemistry Using Laboratory Practical Activities

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	21002.931 ^a	4	5250.733	223.60	.000	.725	
Intercept	16565.261	1	16565.21	705.46	.000	.675	
Pretest Attit	12299.186	1	12299.16	523.79	.000	.607	
Methods	2820.667	1	1410.334	60.061	.000	.262	
Gender	913.844	1	913.844	28.914	.051	.300	NS
Error	7960.278	152	23.482				
Total	1157590.000	160					
Corrected Total	28963.209	159					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result in Table 5 also showed the ANCOVA of the difference between the attitudes mean scores of male and female students' taught chemistry using laboratory practical activities. The result was statistically significant at (F) = 28.91. Since the associated probability value of 0.051 is greater than 0.05 set as level of significance, the null hypothesis was accepted. Thus, inference drawn is that there is no statistically significant difference between the attitudes mean scores of male and female students' taught chemistry using laboratory practical activities. The result further showed the effect size ($\eta^2_p = 0.300$), which indicates that thirty percent (30%) variance in the attitude mean scores of male and female students' taught chemistry using laboratory practical activities can be accounted for by gender.

Discussion of Findings

Evidence from the findings showed that laboratory practical activities had positive effect on the attitude mean scores of students in Chemistry. Implying that,

laboratory practical activities had a significant effect on chemistry students than the lecture method. The finding of the study showed that there was a statistically significant difference between the attitudes mean scores of students in chemistry when exposed to laboratory practical activities and conventional lecture method in favour of laboratory practical activities with high mean. The result further showed the effect size ($\eta^2_p = 0.350$), which indicates that thirty five percent (35%) variance in the attitude mean scores of students in chemistry when exposed to laboratory practical activities can be attributed to the use of lecture method. Lecture method is typically teacher-centered and often fail to engage students actively. The traditional lecture teaching method, otherwise known as the “chalk and talk” method is one in which the teacher verbally present ideas, concepts and facts to students. In contrast, laboratory practical activities involves students in active participation by having them think about a problem, discuss it with a partner, and then share their insights with the larger group. This process not only fosters critical thinking and deeper understanding but also enhances knowledge retention. Similarly, Collaborative learning is another significant advantage of laboratory practical activities over conventional lecture methods. This finding agree with Okam and Zakari (2016) who investigated the impact of laboratory-based teaching strategy on students’ attitude and mastery of chemistry concepts in Katsina Local Government Area and found that students taught using laboratory teaching strategy performed better and showed positive attitudes more than the students taught using lecture method. The finding also agree with Ajanaku (2024), who investigate the effects of hands-on teaching strategy on senior secondary Chemistry students’ attitude towards organic chemistry in Ilorin metropolis, Kwara State, Nigeria and found that students’ attitude towards Chemistry was positive after treatment; students taught with hands-on teaching strategy performed better than those taught using conventional teaching method.

Result further showed that there is no statistically significant difference between the attitudes mean scores of male and female students’ taught chemistry using laboratory practical activities. Reason is that, both male and female students’ find the laboratory practical activity method of teaching interesting and this had effect on their attitude towards chemistry. Also, engaging male and female students in laboratory practical experiments allows them to visualize and directly interact with chemical phenomena, which facilitates a deeper grasp of complex concepts in chemistry. This agrees with the finding of Okam and Zakari (2016) who investigated the impact of laboratory-based teaching strategy on students’ attitude and mastery of chemistry concepts in Katsina Local Government Area and found that there was no significant difference between the attitudes mean scores of male and female students in chemistry concept in the experimental group. The study finding disagree with Jack and Zuairu (2022) who investigated the influence of gender on secondary school students’ achievement, retention and attitude in

chemistry using 4MAT teaching model in Jalingo Education Zone of Taraba State and found that there was statistically significant difference between the attitude mean scores of male and female students taught chemistry using 4MAT and Demonstration Method; the effectiveness of treatment administration and difference between the research location could be possible reasons for the disagreement in findings.

Conclusion

Since the finding of the study showed that there was a statistically significant difference between the attitude mean scores of students in chemistry when exposed to laboratory practical activities and conventional lecture method in favour of laboratory practical activities with high mean; there was no statistically significant difference between the attitude mean scores of male and female students taught chemistry using laboratory practical activities; there was no statistically significant interaction effect of methods and gender on students' attitude mean scores in chemistry. It is therefore concluded that the use of laboratory practical activities which is student-centered was found to improve the attitude of the students towards chemistry positively and that laboratory practical activities as a method of teaching is gender friendly.

Based on the findings of this study, the following recommendations were made:

1. Chemistry teachers should therefore be encouraged to prepare laboratory experiment for every topic and use the experiments in chemistry textbooks and workbooks recommended by the ministry of education.
2. Chemistry teachers should be intentional with managing the allotted lesson time well enough to accommodate the use of laboratory practical activities for effective teaching and learning of Chemistry.
3. Government at various levels should organize seminar and workshops for Chemistry teachers so as to improve their knowledge in the use of practical activities in teaching and learning Chemistry.

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