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EFFECTS OF ACTIVITY- BASED STRATEGY ON STUDENT ATTITUDE AND ACHIEVEMENT IN CHEMISTRY IN SENIOR SECONDARY SCHOOLS, FEDERAL CAPITAL TERRITORY ABUJA, NIGERIA

[1]Aminu Abdulkarim, [1]R.G. Dajal (PhD) and [1]I.A. Ojelade (PhD)
E-Mail: abdulalameen92@gmail.com/ bobydajal2@gmail.com/ nikeojelade@yahoo.com

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Abstract
This paper was motivated by the need to determine the influence of an inquiry teaching strategy on students' attitudes and achievement in chemistry. This study was conducted to determine the effects of Activity-Based Strategy on the Attitude and Achievement of Students in Chemistry in Senior Secondary Schools in the Federal Capital Territory, Abuja. This study employed a quasi-experimental design. Specifically, the study applied a pre-test, post-test non-randomized control group. The study population comprised all SS II Chemistry students in public senior secondary schools in the Federal Capital Territory, Abuja. The sample size of the study was 98 (SS II) chemistry students drawn through simple random sampling and purposive sampling procedures. The instruments used for data collection were Chemistry Attitude Scale (CAS) and Chemistry Achievement Test (CAT) developed by the researcher. The instruments were validated by three experts in science education. The reliability index of the Chemistry Attitude Scale was determined using Cronbach's alpha, which gave an index of 0.72, while the Chemistry Achievement Test was also pilot tested in the same school, and the reliability index was determined using Kuder-Richardson formula (Kr-21), which gave an index of 0.81.The data obtained from the study were analyzed using mean and standard deviation to answer the research questions while the two hypotheses were tested at 0.05 level of significance using ANCOVA. The results revealed that students taught using activity-based strategy had higher mean achievement mean and attitude score than those taught using conventional chemistry methods. Hence, the activity-based strategy was found to be a facilitative instructional strategy for improving the mean achievement and attitude scores in senior secondary school chemistry. It was therefore recommended among others that chemistry teachers should be encouraged to incorporate an activity-based strategy of teaching since this method provides the opportunity to engage students in learning activities and encourages their achievement toward chemistry.

[1] Dept. of Science and Environmental Education, Faculty of Education, University of Abuja

Introduction

Chemistry is a science subject taught in secondary schools in Nigeria. Chemistry is the study of matter, its composition, the combination/separation of substances to form other substances, and their interactions with energy (Bagley, 2017). The importance of chemistry in the development of any nation cannot be underrated, especially in Nigeria, where the national income rests on petroleum and petrochemical industries. Considering the great importance of chemistry in our national development, the government, researchers, chemistry teachers, Science Teachers' Association of Nigeria (STAN), and other agencies are making efforts to improve the achievement of students in Chemistry. Despite the benefits of chemistry to human development and national development, students' attitudes and achievement in the subject are not encouraging. This raises serious concerns for stakeholders in the education sector and the nation at large. Reports from scholars and educators, such as Okorie (2015) and Akpoghol (2016), have indicated that the low achievement of students in chemistry may be linked to frequent use of conventional teaching methods.

The Conventional method involves the verbal presentation of ideas, concepts, generalizations, and facts by a teacher who does most of the activities in the form of talking while students are either passive listeners or are slightly involved. The method is said to be ineffective in teaching science chemistry inclusive as it does not promote active learning of chemistry through minds on hands or more so, the Conventional lecture method of Chalk and talk that is largely used by most teachers are challenged for their inability to foster critical thinking, holistic learning environment among learners and does not consider individual differences existing in each class as their abilities vary considerably and thereby not meeting the different needs of the students (Shafiu, 2014). Consequently, there is a growing interest in exploring innovative teaching strategies such as problem-based learning, cooperative learning and activity-based teaching strategies that can enhance students' attitude and achievement in chemistry.

Achievement and a positive attitude toward chemistry can be enhanced through a paradigm shift from the use of ineffective methods of teaching to an approach that would enhance the development of science process skills, which will lead to the development of a scientific attitude and enable students to construct knowledge on their own. One such teaching strategy is activity teaching strategy.

Activity-based strategy is a teaching method whereby learners are engaged actively in the learning process rather than passively absorbing lectures. It is based on the core premise that learning should be based on doing some hands- on experiments and activities rather than just listening to lessons. This method involves reading, writing, demonstration, discussion, and conducting practical activities and engagement in solving problems, analysis, synthesis, and evaluation. In activity-based teaching, a teacher functions as a facilitator, assisting students through the learning process and providing guidance. Various actions and tasks can be used in this type of program, allowing students to become directly involved in the learning process rather than remaining passive. The reason of activity-based teaching is for a teacher to engage students directly, drawing them into a lesson so that they become participants in their own learning. An activity-based teaching strategy helps students to improve their achievement and boost their attitude toward Chemistry. (Anugwo & Asogwa, 2015)

Activity-based instructional strategy have been identified as an effective instructional strategy for teaching and learning science and mathematics in countries such as South Africa, Kenya, Zimbabwe, Ghana, and so on (Ahmed & Solomon 2019). Their findings revealed a significant improvement in students' achievement and attitude when teaching using an activity-based instructional strategy. However, the extent of the use of activity based instructional strategy has not been fully confirmed in Senior Schools and chemistry as a subject. Thus, in order to bridge the gap and present an effort to rectify the staggering decline in students' achievement, this study

investigated the effects of an activity- based learning strategy on students' attitudes and achievement in secondary school in chemistry in Federal Capital Territory Abuja.

Statement of the Problem

Chemistry is a basic science subject that is needed for sustainable development. Its knowledge is important in the manufacturing of fertilizer, insecticides, food processing and storage, management of natural resources, provision of food and health facilities, and a favorable living environment. In spite of the benefits of chemistry to human development and national development, students' attitudes and achievement in the subject are not encouraging. To confirm this, the results of the senior school certificate examination (NECO) in the years 2019, 2020, 2021, 2022, and 2023 revealed that in 2019, the percentage of students who had a credit pass in chemistry was 50%; in 2020, 58%; 2021, 45%; 2022, 60%; and 2023, 60%. Considering the status and importance of chemistry in various aspects of our life, this lack of stability in achievement and negative attitudes toward the subject should not be allowed to continue. This raises a serious concern to stakeholders in the education sector and the nation at large. The problem has continued to generate several research concerns among stakeholders on the underlying forces responsible for, as well as possible ways to combat this poor trend. Reports from scholars and educators, such as Okorie (2015) and Akpoghol (2016), have indicated that students' achievement in chemistry is linked to teaching strategies. The problems of students under achievement in chemistry have been observed by many researchers and viewed in different angles. Atadoga and Lakpini (2013) argued that teaching chemistry subjects in secondary schools using lecture methods is teacher-centered. Chemistry teachers are familiar with the use of several teaching methods, but more especially conventional/traditional methods such as lecture, discussion and demonstration methods.

In view of these issues, a great deal of effort has been made by chemistry educators to address these problems (Olorundare, 2015). Several innovative strategies were introduced and used to make learning chemistry more experiential and improve students' achievement. However, most students continued to perform below the average. Thus, effective learning in chemistry could include using a more learner-centered strategy, such as an activity-based instructional strategy.

However, the extent of the use of activity based instructional strategy has not been fully confirmed in Senior Schools and in the area of chemistry. Thus, in order to bridge the gap and present effort to rectify the staggering decline in students' achievement, therefore, the problem of this study was to investigate the effects of an activity-based learning strategy on students' attitude and achievement in secondary school in chemistry in Federal Capital Territory Abuja.

Purpose of the Study

The main purpose of this study was to determine the effects of an Activity-Based Strategy on the Attitude and Achievement of Students in Chemistry in Senior Secondary Schools in Abuja Municipal Area Council. The specific objectives of the study were as follows:

i. Determine the difference between the mean attitude scores of students teaching chemistry using an activity-based strategy and those teaching chemistry using a conventional method;

ii. determine the difference between the mean achievement scores of students taught chemistry using an activity-based strategy and those taught using conventional Method;

Research Questions

The following research questions were raised to guide the study:

1. What is the difference between the mean attitude scores of students teaching chemistry using an activity-based strategy and those taught using conventional Method?

2. What is the difference between the mean achievement scores of students taught chemistry using Activity–Based strategy and those taught chemistry using conventional Method?

Hypotheses

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

$H0_1$: There was no significant difference between the mean attitude scores of students taught chemistry using Activity–Based Strategy and those taught using conventional Method.

$H0_2$: There was no significant difference between the mean achievement scores of students taught Chemistry using Activity–Based Strategy and those taught using conventional Method.

Methodology

This study employed a quasi–experimental design for the pre – test, post – test, and non-randomized control group. The quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on its target population without random assignment. The population of this study comprised one thousand nine hundred and fifteen (1,915) SS II Chemistry students in public senior secondary schools in the Federal Capital Territory, Abuja.

A sample size of 98 senior secondary two (SS II) chemistry students formed the sample of the study; a multi-stage sampling procedure was adopted to obtain the sample as more than one sampling technique was adopted at various stages of selection. Precisely, simple random sampling was used to draw one area council out of six area councils. In the second stage of sampling two co-educational schools were selected using a purposive sampling method? The instruments used for data collection were designed by the researchers titled; Chemistry Attitude Scale (CAS) and Chemistry Achievement Test (CAT). The Chemistry Attitude Scale (CAS) was used to test students' attitudes before and after treatment. The Chemistry Attitude Scale (CAS) has two sections: A and B. Section A sought responses on students' personal data, such as sex, and section B consisted of 4 point rating scale responses of Strongly Agree SA, Agree A, Disagree D, and Strongly Disagree SD on students' attitude toward chemistry learning. The instrument consisted of fifteen (15) items. Students were asked to indicate their preference in agreement with the rating given in the statement. Each item was rated on a 4-point scale as follows: Strongly Agree (SA) =4, Agree (A)=3, Disagree (D)=2, Strongly Disagree (SD)=1 for positive responses, while for negative responses, it was arranged as follows; Strongly Agree (SA) =1, Agree (A)=2, Disagree (D)=3, Strongly Disagree (SD)=4

The Chemistry Achievement Test (CAT) was used to measure students' chemistry concept achievement. The instrument consisted of 20 (20) multiple-choice items with four (4) option letter A-D. The test items were based on the concepts of acidity, base, and chemical equilibrium.

The Chemistry Attitude Scale (CAS) and Chemistry Achievement Test (CAT) were subjected to both face and content validity. The validation of these instruments was performed by two experts from the Department of Science and Environmental Education and one expert from the Department of Educational Foundation to check the face and content validity.

After validation, the CAS and CAT were subjected to a pilot test to determine the reliability of the instruments. The researchers conducted a pilot test using one intact class of Thirty-Five (35) students in a school that was not part of the sample selected. The reliability of the Chemistry Attitude Scale was determined using Cronbach's alpha, which gave an index of 0.72, while the Chemistry Achievement Test was also pilot tested in the same school, and the reliability index was determined using the Kuder–Richardson formula (Kr-21), which gave an index of 0.81. This showed that the instruments were reliable.

The students were taught using Activity-Based Strategy for the experimental group and the conventional method for the control group for 8 weeks after which test was conducted for the two groups. The scripts were marked and scored with the use of marking scheme. The marks obtained from the pretest and post-test were used as data that were also used to determine the effectiveness of the activity-based strategy in students' attitudes and achievement in chemistry.

The data collected from the pretest and posttest scores of the secondary school students were analyzed using frequency count, mean scores, and standard deviation to answer the research questions, while an ANCOVA at a 0.05 level of significance was used to test the null hypothesis. The analysis was computer-based using the Statistical Package for Social Sciences (SPSS), Version 23. This was used to determine whether there was a significant difference between the mean scores of the experimental and control groups, which is Activity–Based Strategy and Conventional Method.

Results

The analysis of the data according to research questions and the test of hypotheses used in the study were presented as follows;

Research Question One: What is the difference in the mean attitude scores of students taught chemistry using activity–based strategy and those taught using a conventional method?

Table 1: Mean and Standard Deviations of Attitude Scores for Experimental and Control Groups

Group	N	Mean	SD
Experimental	50	2.37	0.89
Control	48	2.35	0.75
Mean difference		0.02	
Total	98		

Table 1 shows the mean and standard deviation of students taught chemistry using activity based strategy and those taught using conventional methods. From the results obtained, students in the experimental group taught chemistry concept using activity – based strategy had a mean attitude score of 2.37 with a standard deviation of 0.89 while the students in the control group taught using conventional method had a mean attitude score of 2.35 with a standard deviation of 0.75. Therefore, the mean difference in attitude scores of students in the experimental and control groups was 0.02 in favor of students taught chemistry using activity–based strategy. This indicates that students in the experimental group had higher mean attitude scores than their counterparts in the control group.

Research Question Two: What is the difference in students' achievement toward chemistry when taught using activity–based strategy and when their counterparts are taught chemistry using a conventional method?

Table 2: Mean and standard deviation of mean achievement scores of the experimental and control groups

Group	N	Mean	SD
Experimental	50	29.30	4.31
Control	48	25.00	3.42
Mean difference		4.30	
Total	98		

Table 2 shows the mean and standard deviation of achievement scores of students taught chemistry using activity–based strategy and those taught using a conventional method. From the results obtained, students in the experimental group (taught with activity – based strategy) had a mean achievement score of 29.30 with a standard deviation of 4.31, while the students in the control group taught using conventional method had a mean achievement score of 25.00 with a standard deviation of 3.42. Therefore, the mean difference in achievement scores of students in the experimental and control groups was 4.30 in favor of students taught chemistry using activity–based strategy. This shows that students who taught chemistry using the activity-based strategy had higher achievement scores than their counterparts taught using conventional strategy.

Ho_1: There was no significant difference in the mean attitude scores of students taught chemistry using activity–based strategy and those taught with the conventional method.

Table 3: ANCOVA Results of Attitude Scores of Students Taught Chemistry Using Activity–Based Strategy and Those Taught Using Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	63.817[a]	2	31.908	1411.375	.000
Intercept	.092	1	.092	4.061	.047
Pretest	63.806	1	63.806	2822.290	.000
Treatment	.426	1	.426	18.857	.000
Error	2.148	95	.023		
Total	612.667	98			
Corrected Total	65.964	97			

Sig. at $p < 0.05$

Table 3 shows the ANCOVA results of the attitude scores of students taught Chemistry using activity-based strategy and those who were taught using a conventional method. The results from the table revealed that the main treatment had F 1, 97 = 18.857, and p = 0.00. The significant value p-value (0.00) was less than 0.05. Therefore, null hypothesis one was rejected. Hence, there was a significant difference in the mean attitude scores of students taught chemistry using activity–based strategy and those taught using the conventional method in favor of experimental group.

Ho_2: There was no significant difference in the mean achievement scores of students taught Chemistry using activity–based strategy and those taught using conventional Method.

Table 3: ANCOVA Results of Achievement Scores of Students Taught Chemistry Using Activity- Based Strategy and Those Taught Using Conventional Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1179.105[a]	2	589.552	76.491	.000
Intercept	604.895	1	604.895	78.481	.000
Pre-test	726.288	1	726.288	94.231	.000
Group	308.682	1	308.682	40.050	.000
Error	732.212	95	7.707		
Total	74383.000	98			
Corrected Total	1911.316	97			

Sig. at $p < 0.05$

Table 3 shows the ANCOVA results of the achievement scores of the students who were taught Chemistry using the activity-based strategy and their counterparts who were taught the conventional method. The results from the table show that F 1, 97 = 40.050, and p = 0.00 for the main treatment. The significant value p-value (0.00) was less than 0.05. Therefore, null hypothesis two was rejected. Hence, there was a significant difference in the mean achievement scores of students taught chemistry using activity–based strategy and those taught using the conventional method in favor of experimental group.

Discussion of Findings

The findings of the study revealed that the mean attitude scores of students taught chemistry using activity-based strategy in the experimental group had higher mean attitude scores than their counterparts in the control group taught using the conventional method. Specifically, the result from the tested hypothesis showed that there was a significant difference between the mean attitude scores of students in the experimental group exposed to the activity-based strategy and their counterpart in the control group exposed to the conventional method. These findings affirm the results of Nazimuddin, (2015), Dajal and Mohammed (2019) and Uzezi and Deya (2020), who revealed that the exposure of learners to innovative instructional strategies, such as activity-based strategy boost students' attitudes in science (chemistry) inclusive. The reason for the difference is that the activity-based strategy is an activity-oriented teaching method that attracts attention, engages learners, sustains motivation, and boosts their attitude toward chemistry.

The findings of the study revealed that the mean achievement score of students who were taught chemistry using an activity-based strategy in the experimental group had a higher mean achievement than their counterparts in the control group who were taught using the conventional method. Specifically, the result from the tested hypothesis showed that there was a significant difference between the mean achievement scores of students in the experimental group exposed to the activity-based strategy and their counterpart in the control group exposed to the conventional method. The results of the study support the views of previous researchers like Albadi, and David (2019), Sani and Dajal (2022), who indicated that students' achievement is greatly improved when taught with innovative teaching strategy. This could also be due to the fact that activity-based strategy has the potential to make students learn more because fun and entertainment are naturally ways through which students learn, therefore improving the achievement of students. This finding also agrees with Ojelade, Dajal, and Badamasi (2024), who found that the innovative teaching strategy was more effective than traditional teaching methods in terms of enhancing students' achievement. This could be due to the fact that an activity-based strategy is an activity-oriented teaching method that encourages active participation of students in class room activities and maximizes comprehension of subject matter. ThisIt means that the method can be used to teach students since it reduces the problem of poor achievement and stimulates their interest in chemistry.

Conclusion

The researchers, however, concluded based on the results in this study that the use of an activity-based strategy enhances the academic achievement of students in chemistry as well as their attitude compared with the conventional method. With an activity-based strategy, students learn better in chemistry, perform their responsibilities, and make an effort to achieve stated objectives.

Recommendations

The following recommendations were made based on the findings of this study.

1. Chemistry teachers should be encouraged to incorporate an activity-based strategy of teaching since this method provides the opportunity to engage students in learning activities and encourages their attitudes toward chemistry concepts.

2. The curriculum planners should plan the nation‘s Chemistry Science Curriculum to accommodate an inquiry-based science Programme for the students and should allocate more time to chemistry in the school time table to enable the application of activity-based strategy.

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