



ENHANCING SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS' ACADEMIC ACHIEVEMENT USING FLIPPED CLASSROOM INSTRUCTIONAL STRATEGY IN NIGER STATE, NIGERIA

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Abstract

The study investigated the strength of flipped classroom instructional strategy in enhancing senior secondary school chemistry students' academic achievement in Niger State, Nigeria. The study was guided by two research objectives. The study adopted quasi-experimental of protest post-test non-equivalent control group design. The population of the study comprised all Chemistry students in the entire secondary school in Minna metropolis, Niger State, Nigeria. The target population for this study consisted of all senior secondary school two (SSII) Chemistry students with a total number of one thousand eight hundred and twenty one (1821) Chemistry students, comprising of 766 males and 1055 females. Simple random sampling technique was used to select two schools from the population. The two schools were selected using balloting. One hundred and ten (110) senior secondary school two (SSII) Chemistry students were sampled comprising forty eight (48) males and fifty two (52) females and took part in the study. Chemistry Achievement Test (CAT) was used for data collection in this study. Chemistry Achievement Test (CAT) was validated by three senior lecturers from Science Education Departments and Chemistry Department, Federal University of Technology. The reliability of CAT was established using split-half reliability method and the coefficient was calculated using Spearman Brown's Formula and it was found to be 0.832. Mean and standard deviation were used to answer the research question while the hypotheses were tested at 0.05 significance level using z-test for independent sample statistical tool. The findings from the study indicated that there was no significant difference in the mean achievement score between chemistry students taught using flipped classroom and those taught using Lecture method. Based on the findings of this study, it was concluded that Chemistry students' academic performance improves when taught using flipped classroom. It was recommended among others that Chemistry teachers should employ the use of flipped classroom in teaching the subject to foster students' academic achievement. Equally, ministry of education should organized workshop and seminar to train science teachers on how to use flipped classroom to teach science subjects.

Keywords: Flipped Classroom, Academic Achievement, Chemistry Students

Introduction

Science education is the underlying basis for national progress by protecting human communities from ignorance, illiteracy, diseases and poverty. It is a field of specialization concerning with two basic aims, which are the production of scientifically interactive society and technological manpower. The development of any nation depends on its innovation due to science and technology as a result emphases are laid on science learning. The science related

disciplines that will enable learner to have true knowledge of science and be able to use it in solving problem are Physics, Chemistry, Biology and Mathematics.

In Nigeria, chemistry has provided the theoretical base for the synthesis of medicines, soap, paints, shoes, textiles, detergents and cosmetics, fertilizers, cement, ceramics, margarine, plastics, glass. Jegede (2017) affirmed that chemistry occupies a central position among the science because of its remarkable contributions in areas such as petroleum, engineering, medicine, textile industry, agriculture, pharmacy etc. Knowledge of chemistry helps to position students in undertaking numerous career opportunities such as chemists, pharmacists, doctors, chemical engineers, biochemists, agricultural scientists, geologists among others.

Despite the increasing importance and usefulness of chemistry to the world at large, and Nigeria in particular, the secondary school students' performance in the subject remain discouraging. Serious concern has been expressed by parents and the society in relation to the poor performance of students in chemistry in the senior school certificate examinations. chemistry education for the 21st-century is geared towards enhancing high-level cognitive skills such as critical thinking, metacognition, and deep conceptual understanding which may assist in fostering students' academic achievement (Bao & Koenig, 2019). This is the principle behind Flipped classroom and therefore the study used flipped classroom to go beyond traditional method in order to overcome students learning difficulties.

Flipped classroom is an innovative instructional strategy that entails the use of internet-based individualized instruction outside the classroom and interactive group learning activities inside the classroom. Flipped classroom is an instructional design that replaces the traditional lecture-in-class with assigned learning activities outside the class and back into the class for interactive learning where the teacher guides the students as they apply concepts and engage creatively in the subject (Talan & Gulsecen, 2019). The flipped classroom is an innovative learning strategy that is different from the traditional face-to-face learning method in the sense that students learn their lessons at any time and wherever they want before coming to school. In this way, students learn the contents with their teachers' instructions and the contents are conveyed to them before lessons.

The flipped instruction also involves helping students to use the class time to enhance what they had studied initially at home by participating in group discussions, engaging in laboratory activities, and projects that involve higher level thinking Cabi (2018). In flipped classroom students take ownership of their own learning and teachers talk with students. The entire paradigm of teaching moves from a traditional model of teachers as imparters of knowledge towards a model of teachers as facilitators and coaches who carefully observe students, identify their learning needs and guide them to higher levels of understanding hereby improving their academic achievement (Shao & Liu, 20 21)

Academic achievement as a measure of what a person has accomplished after exposure to an educational programme. It is a means of accomplishment or proficiency of performance in a given skills or body of knowledge. Abumchukwu and Okeke (2020) opined that students' academic achievement corresponds to their performance in school subjects as symbolized by a score on achievement test. It is commonly measured by means of examination or continuous assessments, it represent the level of success of the teaching and learning process, it indicate the extent to which the established goal have been achieved, it also provides feedback to the teacher and student. Academic achievement of students at all levels of education has been a subject of concern by many people including parents, administrators, educators, psychologists and counsellor. Students are irritated by persistent low academic achievement due to learning difficulties associated with different concept in chemistry. Maala (2023) noted that one of the most worrying issues in learning chemistry is how students understand concept. Using

innovative and more engaging instructional strategy can make students have deeper understanding of concept, gain reasonable academic achievement irrespective of their gender.

Gender is any physical and behavioral difference between male and female which are socially, culturally based. Researches on gender and academic achievement like that of Abumchukwu and Okeke (2020) observed that boys achieved better than girls. Researches on gender such as Marni, et al. (2020) found out that male and female students possess almost the same level of critical thinking skills. Anna and Franca (2022) found no significant difference between the mean critical thinking skills scores of male and female taught using scaffolding instructional strategy. There seems to be an inconsistency in the findings on gender and these needs to be filled by other studies. Also lack of critical thinking skills will negatively affect the quest to compete effectively in the global market and therefore investigate the strengths of advance organizer in enhancing Chemistry students' critical thinking skills in Niger State, Nigeria.

Statement of the Problem

Lack of learners' engagement is a significant challenge for educators seeking to cultivate enhances academic achievement among their students. Teaching strategy which is characterized by rote memorization and passive learning hinders the students from understanding the concept well. Significantly, chemistry is a key subject with the potential of making students acquire and use relevant 21st century skills required for national development which may in turn assist in promoting academic achievement of students.

The combination of this factors create the need for research aimed at investigating and implementing effective strategies that foster chemistry students' academic achievement. Specifically, the research aims to explore how flipped classroom can be employed to bridge the gap between traditional teaching practices and contemporary, engaging learning method. The researcher's attention was therefore drawn to investigate the strengths of flipped classroom in enhancing chemistry students' academic achievement in Minna metropolis, Niger State, Nigeria.

Aim and objective

The main aim of this study is to investigate the effects of flip classroom on the academic achievement and interest of senior secondary school student in chemistry in Minna Metropolis. The following objective were set to guide the study:

1. determine the effects of flipped classroom on the academic achievement of secondary school chemistry student in in Minna Metropolis
2. determine the effects of flipped classroom on the academic achievement of secondary school chemistry student in in Minna Metropolis based on gender

Research Question

1. What is the difference in the mean academic achievement score of chemistry student taught using flipped classroom and those taught using lecture method
2. What is the difference in the mean academic achievement score of male and female chemistry student taught using flipped classroom and those taught using lecture method

Null Hypothesis

HO₁: There is no significant difference in the mean academic achievement score of chemistry student taught using flipped classroom and those taught using lecture method.

HO₂: There is no difference in the mean academic achievement score of male and female chemistry student taught using flipped classroom and those taught using lecture method

Methodology

The study adopted quasi-experimental of protest post-test non-equivalent control group design; this is because quasi-experimental design is a type of experimental design that does not allow for full control of extraneous variable and does not give room for random assignment of subject to group (Creswell, 2011). In this design both groups were subjected to pre-test and post-test before and after the treatment respectively. The population of the study comprised all Chemistry students in the entire secondary school in Minna metropolis, Niger State, Nigeria. The target population for this study consisted of all senior secondary school two (SSII) Chemistry students with a total number of one thousand eight hundred and twenty one (1821) Chemistry students, comprising of 766 males and 1055 females. Simple random sampling technique was use to select two schools from the population. The two schools were selected using balloting. However, an intact class was used and assigned school into experimental and control group. One hundred and ten (110) senior secondary school two (SSII) Chemistry students were sampled comprising forty eight (48) males and fifty two (62) females and took part in the study.

Chemistry Achievement Test (CAT) was used for data collection in this study. It was developed by the researcher; it consisted of thirty (30) multiple-choice items with option ranging from A-D from which students are expected to choose the correct responses. The questions were adapted from West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO) past questions. The items of instrument were scored two mark for each correct answer and zero for each incorrect answer. Marking guide was prepared in order to guide the marking of the students' script. The maximum score is 60 marks (100%) while the minimum score is 0 marks (0%). Chemistry Achievement Test (CAT) was validated by three senior lecturers from Science Education Departments and Chemistry Department, Federal University of Technology. Two schools apart from those selected for the main study were used for pilot testing of the instrument. The reliability of CAT was established using split-half reliability method and the coefficient was calculated using Spearman Brown's Formula and it was found to be 0.832.

The researcher visited the sampled schools and sought for their permission to conduct the study and addressed the principals and all Chemistry teachers on the duration and nature of the treatment of the study. At the beginning of the study, experimental and control group were subjected to pre-test to determine their level of achievement before treatment. Experimental group was taught using flipped classroom while control group was taught using Lecture method. The students in both groups were taught for five weeks. Immediately after the intervention, the researcher administered the post-test CAT to both experimental and control group. The data obtained from the pre-test and post-test were marked and subjected to data analysis using (SPSS v. 26.0) for both descriptive and inferential statistical tool. Mean and standard deviation were used to answer the research question while the hypotheses were tested at 0.05 significance level using z-test for independent sample statistical tool.

Result and Discussions

Pre-test scores were analysed using mean and standard deviation to ascertain the homogeneity or otherwise between control and experimental group. Therefore pre-test has no effect on the academic achievement of experimental and control group and is presented in Table 1.

Table 4.1: Analysis of Pre-Test Using Mean and S.D of Academic Achievement Scores of the Experimental and Control Groups Prior to Treatment

Group	N	Mean	SD	Mean Diff.
Experimental	49	11.16	2.62	0.19
Control	60	10.97	2.80	

Table 1 shows the pre-test mean academic achievement score of the experimental and control groups prior to treatment. The mean and standard deviation of experimental group are 11.16 and 2.61 while that of control group are 10.97 and 2.80. The pre-test mean difference is 0.19 and this indicates that the experimental and control group were comparable and suitable for the experiment since they have very close pre-requisite academic achievement before treatment. However, the responses of students made on the test indicate closer performance in the experimental group with S.D of 2.61 compared to control group with S.D of 2.80.

Analysis of Research Question and Null Hypotheses

Research Question One: What is the different in the mean academic achievement score of student taught chemistry using flipped classroom and those taught using lecture method? Mean and S.D. were used to answer this research question one and is presented in Table 2

Table 2: Analysis of Mean and S.D of Academic Achievement Scores of the Chemistry Students in Experimental and Control Groups

Group	N	Mean	S.D	Mean Difference
Experimental	49	71.31	8.912	3.07
Control	60	68.07	8.974	

Table 2 indicates that, students exposed to flipped classroom had a mean achievement score of 71.31 with standard deviation of 8.912 while those exposed to lecture method had a mean achievement score of 68.07 with standard deviation of 8.974. The mean difference between the groups is 3.07 and this result indicates that students taught using flipped classroom had high mean achievement scores than those taught using lecture method and therefore performed slightly better than control group.

H₀₁ There is no significant different in the mean academic achievement scores of student taught chemistry using flipped classroom and those taught using conventional lecture method.

Hypothesis one was tested using independent sample z-test using SPSS version 26 at 0.05 level of significant and is presented in table 3

Table 3: Analysis of z-test of Academic Achievement Scores of the Chemistry Students in Experimental and Control Groups

Group	N	Mean	S.D.	Z	Df	P-value	Decision
Experimental	49	71.31	8.912	1.881	107	0.063	Not Sig
Control	60	68.07	8.974				

Table 3 presents the result of independent sample z-test analyses for posttest mean achievement scores of the experimental and control groups, the observed p-value is 0.063 and the alpha-value is 0.05 with df=107. Therefore, the observe p-value is greater than the alpha-value and thus the null hypothesis is hereby accepted. Therefore, there was no significant difference in the mean achievement score between students taught chemistry using flipped classroom and those taught using lecture method (z-crit=1.881, df=107, p=0.000>0.05).

Research Question Two: What are the mean academic achievement scores of male and female student taught chemistry using flipped classroom and those taught using lecture method? Mean and SD were used to answer this research question and is presented in Table 4.

Table 4: Analysis of Mean and S.D of Academic Achievement Scores of the Male and Female Students in Experimental Group

Gender	N	Mean	SD	Mean Diff.
Male	28	70.76	9.731	0.57

Female	21	70.19	9.300
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Table 4 indicates that, male students exposed to flipped classroom had a mean achievement score of 70.76 with standard deviation of 9.731 while female students exposed to the same method had a mean achievement score of 70.19 with standard deviation of 8.300. The mean difference between the groups is 0.57 and this result indicates that male students taught using flipped classroom had slightly higher mean achievement scores than their female counterpart taught using the same method. The result shows that male in experimental group exposed to flipped classroom performed slightly better than their counterpart female.

H₀₂ There is no significant different in the mean academic achievement scores of male and female student taught chemistry using flipped classroom.

Hypothesis two was tested using independent sample z-test using SPSS version 26 at 0.05 level of significant and is presented in table 5.

Table 5: Analysis of z-test of the Mean Academic Achievement Scores of Male and Female Chemistry Students in Experimental Group

Gender	N	Mean	S.D.	Z	df	P-value	Decision
Male	28	70.76	9.731	0.230	47	0.819	Not Sig
Female	21	70.19	9.300				

Table 5 presents the result of independent sample z-test analyses for posttest mean achievement scores of the male and female students in experimental group, the observed p-value is 0.819 and the alpha-value is 0.05 with df=47. Therefore, the observe p-value is greater than the alpha-value and thus the null hypothesis is hereby accepted or retained. And therefore concluded that there was no significant difference in the mean achievement score between male and female students taught chemistry using flipped classroom ($z\text{-crit} = 0.230, df=47, p=0.819 > 0.05$).

Summary of the Major Findings

1. There was no significant difference in the mean achievement score between chemistry students taught using flipped classroom and those taught using Lecture method.
2. There was no significant difference in the mean achievement score between male and female chemistry students taught using flipped classroom.

Discussion of the Findings

The finding of this study revealed that there was no significant difference in the mean achievement score between chemistry students taught using flipped classroom and those taught using lecture method but an increase in mean which signifies increase in performance was observed. This means that the use of flipped classroom in teaching chemistry concepts enhance students’ academic achievement in the subject. This findings is in agreement with the findings of Elian and Hamaidi (2018) and Cabi (2018). whom found students learned using flipped classroom have enhanced their achievement. The reason for this finding could be as a result of nature and process involved in the teaching method used in which students are allowed to learn and participate fully in the lesson and the learning activities includes the need of different learners.

The finding of this study shows that there was no significant difference in the mean achievement score between male and female chemistry students taught using flipped classroom. This implies that there was no statistical difference in the mean achievement scores between male and female students exposed to flipped classroom. The possible reason that could be attributed to the equal performance across the gender in this study includes equal opportunities given to both male and female students to explore and learn the concept. The

result of this study is in line with the findings of Talan and Gulsecen (2019) and Alamri (2019) who reported that no significant difference in the mean achievement score between male and female was found after students received the treatment.

Conclusion

Based on the findings of this study the following conclusions were drawn:

- i. Chemistry students' academic performance improves when taught using flipped classroom. As such it increases the level of students' academic achievement.
- ii. Flipped classroom help to improve both male and female students' academic achievement as indicated by insignificant difference in their mean achievement scores when taught using the method.

Recommendations

Based on the result of the study, the researcher recommends the following:

1. Chemistry teachers should employ the use of flipped classroom in teaching the subject to foster students' academic achievement. Equally, ministry of education should organized workshop and seminar to train science teachers on how to use flipped classroom to teach science subjects.
2. Chemistry teachers in Niger State, Nigeria should foster reasonable interaction among male and female students while in classroom, as they learn to discover knowledge themselves collaboratively irrespective of their gender.

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