

EFFECT OF FLIPPED CLASSROOM INSTRUCTIONAL STRATEGY ON STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN SENIOR SECONDARY SCHOOLS IN FEDERAL CAPITAL TERRITORY, ABUJA

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ABSTRACT

This study was motivated by the need to enhance learning of chemistry in order to improve students' academic achievement which is always deteriorating over the years. This study investigated the Effect of Flipped Classroom Instructional Strategy on Students' Academic Achievement in Chemistry in Senior Secondary Schools in FCT, Abuja. Two research questions were raised and two null hypotheses were formulated. The research design was quasi experimental non-equivalent control group. The study was carried out in two selected co-educational secondary schools in the Federal Capital Territory, Abuja. A sample size of 104 SS1 chemistry students from two randomly selected intact classes in the sampled schools were used. The instruments for data collection were Chemistry Achievement Test (CAT). The reliability of the CAT was determined using split half method of Kuder Richardson Formula (KR-21) which gave an index of 0.76. Data obtained were analyzed using frequency count, mean score and standard deviation, while Analysis of Covariance (ANCOVA) statistics was used to test the null hypotheses at 0.05 level of significance. The results of the analysis showed that there was a significant difference between the mean achievement scores of chemistry students taught chemistry using the flipped classroom instructional strategy and

their counterpart taught with the conventional method of teaching, and there was no significant difference between the mean achievement scores of male and female students taught chemistry using the flipped classroom instructional strategy. The research concluded that flipped classroom instructional strategy had positive effect on students' achievement in chemistry and it is gender friendly. Based on the findings, the researcher recommended that teachers should use the flipped classroom instructional strategy for teaching and learning processes since it enhances their interest and achievement and it is gender friendly.

Keywords: Flipped Classroom, chemistry, students achievement and Secondary schools

Introduction

A nation's development success heavily depends on excellent science education because it promotes technological advancement and economic growth. Education of science subjects with chemistry acts as an essential process for students to develop their scientific competencies while obtaining innovation abilities according to Kola (2013). The Nigerian government identifies science education as vital at every stage of education yet student success in science education particularly chemistry shows persistent concern. The Federal Republic of Nigeria (2014) emphasizes that quality teaching methods should be employed to enhance student learning and application of science concepts. Traditional educational practices that center on teacher instruction lead to poor chemistry results at secondary schools because they neglect personal learning needs.

Student attention span remains the primary impediment for effectively teaching chemistry during entire classes. Traditional teaching methods utilize direct instruction because teachers provide information which students listen to before recording notes according to Paul and Dantani (2012). The teaching approach creates difficulties for students to learn chemistry concepts since it limits their active participation and stops them from being creative and actually comprehending the material. Abstraction problems in student comprehension lead to deteriorating scores on WAEC West African Senior School Certificate Examination tests. The West African Senior School Certificate Examination results demonstrate declining chemistry test scores since students recall insufficient pass criteria (Asim, Bassey & Essien, 2019). Continuous decline of achievement results from inadequate teaching methods which fail to simultaneously captivate students and improve their chemical comprehension.

Academic researchers have developed new teaching methods to improve student educational experiences. The flipped classroom model represents an educational approach that opposite standard classroom structure by giving students prerecorded material outside the classroom followed by student-led discussions and practical work in class time (Sams et al., 2014). Students can complete their homework using video lectures and digital learning materials before attending the classroom under the flipped classroom method. The instructional shift gives teachers time to conduct active learning sessions so students can practice their knowledge as they work together and get instant feedback from instructors (Hertz, 2015). Fostering student-centered learning through the flipped classroom approach improves students' lasting grasp of chemistry material.

The key success factor of flipped classrooms emerges through their structure that enables personalized study and maximum student engagement. Through personalized studying students can prepare for class by reviewing materials at any time and build questions that enhance classroom discussions (Clark, 2015). This teaching method helps students gain

control of their academic journey while building essential critical thinking abilities needed for successful chemistry understanding. By using interactive principles in flipped learning instructors develop better relationships with students because they can detect specific learning challenges for which they offer personalized educational assistance (Sams et al., 2014). An instructional method featuring flexibility enables learning benefits to reach students of varied academic levels through their unique learning styles.

Despite the numerous advantages of the flipped classroom approach, its implementation faces certain challenges. Some educators are resistant to adopting new teaching methods due to the time and effort required to create video lessons and interactive materials (Clark, 2015). Moreover, the success of flipped learning depends on students' access to digital resources, such as computers and internet connectivity, which may not be readily available to all learners, especially in resource-constrained environments. However, studies have shown that when properly implemented, the flipped classroom model significantly improves student engagement, comprehension, and academic achievement in science subjects (Hertz, 2015). Therefore, integrating this instructional strategy into chemistry education could address some of the limitations of conventional teaching methods and enhance students' overall learning outcomes.

A proper assessment of flipped classroom effectiveness involves analyzing how gender influences student learning outcomes. The learning styles and motivational levels and cognitive processing among students show gender-based differences according to research by Krapp & Prenzel (2011). The results of research studies differ regarding male preference for practical learning methods despite evidence indicating female excellence in group discussions as noted by Clark (2015). The creation of effective educational approaches for chemistry education requires knowledge about student performance dissimilarities between learners.

Repaying attention to a successful instructional methodology which builds student interest and achievement levels in chemistry holds remarkable importance. The flipped classroom model demonstrates potential to replace traditional methods because it brings new possibilities for improving science education throughout Nigeria. This approach leverages technology while utilizing interactive teaching methods to transform traditional chemistry classrooms into active learning spaces where students simultaneously engage with content and solve problems. Senior secondary education success heavily depends on resolving digital access problems as well as developing proper teacher training to implement this model effectively.

A research investigates how using flipped classrooms as an instructional approach affects chemistry examination performance in senior high school education. The evaluation analyzes how this educational method affects student learning outcomes to prove its worth as an alternative education system for modern classrooms. This study determines flipped learning effects on male and female students since gender functions as a moderating variable in the research. New educational methods will receive enhanced discourse through findings that explore their effectiveness in boosting science education throughout Nigeria.

Objective of the Study

The objective of the study was to investigate the effect of flipped classroom instructional strategy on students' achievement in chemistry in senior secondary schools in the Federal Capital Territory, Abuja. Specifically the objectives were to:

- i. determine the difference in the mean achievement scores of senior secondary school

students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching;

- ii. find out the difference between the mean achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference between the mean achievement scores of senior secondary school students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching?
2. What is the difference between the mean achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy?

Hypotheses

The following null hypotheses were formulated for the study and tested at 0.05 level of significance.

H₀₁: There is no significant difference between the mean achievement scores of senior secondary school students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching.

H₀₂: There is no significant difference between the mean achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy.

METHODOLOGY

The design adopted for this study was quasi experimental design, specifically the study applied pretest, posttest non-equivalence, experimental and control group. The population of this study comprised of twenty thousand and sixty-seven (20,067) SS1 chemistry students in senior secondary schools in FCT. Abuja. A Sample size of one hundred and four (104) SS1 chemistry students from two randomly selected schools and two intact classes were used respectively for experimental and control group. The research instrument used for data collection was Chemistry Achievement Test (CAT). The Chemistry Achievement Test (CAT) was used to measure students' achievement in Chemistry concepts. It consists of forty (40) multiple choice items with four (4) options letter A-D. The test items were based on the concept of chemical bonding and properties of compounds formed from different types of bonding. The instrument was subjected to both face and content validity. The validation of CAT was done by two experts from the Department of Science and Environmental Education in University of Abuja. The reliability of the instrument was determined using split half method and Kuder Richardson Formula (KR-21) which gave an index of 0.76.

Data Collection Procedure

The researcher trained regular chemistry teachers in the sample schools to participate and teach in their respective classes. In the first week, pretest was administered to all the students

to determine the entry level of the two groups, after the first week the research assistant went further and taught students for the period of eight weeks. Teacher in the experimental group taught students using prepared lesson plan prepared by the researcher on the topic in question. In control group, the regular teachers used the lesson notes prepared by the researcher which was on use of lecture method without video or ICT resources to teach the same contents as in the experimental group. However, the last one (1) week was used for revision and posttest to all the students involved in the study in order to determine their achievement level. The marks obtained from the pretest and posttest were used as data for this study.

Method of Data Analysis

The data collected from the study were analyzed using frequency count, mean score, and standard deviation to answer the research questions. While Analysis of Covariance (ANCOVA) statistics at 0.05 level of significance was used to test the null hypotheses. The analysis was computer based, with the use of the Statistical Package for Social Sciences (SPSS) Version (23).

Results

Research Question 1: What is the difference between the mean achievement scores of students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching?

Table 1: Mean and Standard Deviation of Achievement Scores of Students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching

Group	N	Mean	SD
Flipped Classroom Instructional	40	18.75	1.51
Conventional Lecture	64	16.31	2.30
Mean difference		2.44	

Table 1 shows the mean and standard deviation of achievement score of students taught chemistry using the flipped classroom instructional strategy and those taught with the conventional method of teaching. From the results obtained, students in experimental group (taught using the flipped classroom instructional strategy) had a mean achievement score of 18.75 with a standard deviation of 1.51 while the students in control group (taught with the conventional method of teaching) had a mean achievement score of 16.31 with a standard deviation of 2.30. Therefore, the mean difference in achievement scores between achievement scores of students in experimental group and control group is 2.44 in favour of students taught chemistry using flipped classroom instructional strategy.

H₀₁: There is no significant difference in mean achievement scores of students taught chemistry using flipped classroom instructional strategy and those taught using the conventional method of teaching.

Table 2: ANCOVA Results of Achievement Scores of Students taught Chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	219.777 ^a	4	54.944	15.554	0.000
Intercept	521.365	1	521.365	147.589	0.000
Pretest	0.386	1	0.386	0.109	0.742
Group/Method	130.446	1	130.446	36.927	0.000
Gender	30.771	1	30.771	8.711	0.004
group *gender	21.836	1	21.836	6.181	0.015
Error	349.723	99	3.533		

Table 2 shows the ANCOVA result of achievement scores of students taught chemistry using the flipped classroom instructional strategy and those taught using the conventional method of teaching. From the table, there is significant difference in achievement to Chemistry among the groups based on methods, $F(1,99) = 36.927$, $P(0.000)$ is less than 0.05 level of significance. Therefore, hypothesis three was rejected as it can be concluded that methods of teaching the groups have significant impact on the achievement of students to Chemistry.

Research Question 2: What is the difference between the mean achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy?

Table 3: Mean and Standard Deviation of Achievement Scores of Male and Female senior secondary school students taught chemistry using the flipped classroom instructional strategy

Gender	N	Mean	SD
Male	23	18.65	1.58
Female	17	18.88	1.45
Mean Difference		0.23	

Table 3 shows the mean and standard deviation of achievement scores of male and female students of experimental group taught chemistry using the flipped classroom instructional strategy. From the results obtained, male students had a mean achievement score of 18.65 with a standard deviation of 1.58 while the female students had a mean achievement score of 18.88 with a standard deviation of 1.45. Therefore, the mean difference in achievement scores between male and female students in experimental group is 0.23 in favour of female students.

H02: There is no significant difference in the mean achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy.

Table 4: ANCOVA Results of Achievement Scores of Male and Female Senior Secondary School Students taught Chemistry using the Flipped Classroom Instructional Strategy.

Source	Type Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	0.638 ^a	2	0.319	0.133	0.876
Intercept	147.837	1	147.837	61.556	0.000
Pretest	0.120	1	0.120	0.050	0.824
Gender	.382	1	0.382	0.159	0.692
Error	88.862	3	2.402		
Total	14152.000	40			
Corrected Total	89.500	37			

Not Sig. at $P > 0.05$

Table 4 shows the ANCOVA result of achievement scores of male and female senior secondary school students taught chemistry using the flipped classroom instructional strategy. From the table, there is no significant difference in mean achievement scores of Chemistry among the group based on gender because $F(1, 39) = 0.050$, $P(0.692)$ is greater than 0.05 level of significance. Therefore, hypothesis two is not accepted as it can be concluded that gender has no significant impacts on the achievement of students taught chemistry with flipped classroom instructional strategy.

Discussion of Findings

The findings of the study revealed that the mean achievement score of students in the experimental group who were taught chemistry using flipped classroom was higher than those in the control group. Similarly, the result showed that there is significant difference in achievement to Chemistry among the groups based on methods, $F(1,99) = 36.927$, $P(0.000)$ is less than 0.05 level of significance. This finding agrees with the study conducted by Albalawi (2018); Talan and Glusecen (2019) Oka and Samuel (2020), who reported that students exposed to learning using flipped classroom instruction achieved significant results than their counterparts taught using ordinary classroom instruction. On the contrary, Saunders (2014) in a similar study found out that flipped classroom is not a significant factor in enhancing students' academic achievement.

The findings of the present study further revealed that female students taught chemistry using flipped classroom in experimental group had slightly higher mean score than male students after treatment. Despite the slight difference in the achievement scores of male and female in the present study, the findings showed that there is no significant difference in mean achievement scores of Chemistry among the group based on gender because $F(1, 39) = 0.050$, $P(0.692)$ is greater than 0.05 level of significance. Therefore, hypothesis two is accepted as it can be concluded that gender has no significant impacts on the achievement of students taught chemistry with flipped classroom instructional strategy. The finding however, agrees with the study conducted by Michael and Mudasiru (2018); Odewumi and Yusuf (2018) that female students performed better than their male counterpart on their exposure to flipped classroom but no significant difference was observed in their achievement. This The findings corroborate the findings of Dajal and Mohammed (2019); Ojelade, Ekpo and Aregbesola (2021) who reported that the gender of students did not influence the achievement of students when they were taught using innovative teaching strategies.

Conclusion and Recommendations

In conclusion, the study revealed that the use of flipped classroom instructional strategy has significant effects on students' interest and achievement in chemistry in FCT-Abuja. This implies that flipped classroom instructional strategy is an efficient method of teaching chemistry in senior secondary schools and it is gender friendly.

The following recommendations were proffered:

1. Teachers should use the Flipped Classroom Instructional Strategy (FCIS) for teaching and learning of chemistry as it has proved to be effective.
2. The Flipped Classroom Instructional Strategy (FCIS) should be used in teaching students because it is gender friendly.

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