GRADIVA

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

Effect of Optimization of Flipped Demonstration on Academic Achievement and Retention of Senior Secondary School Students in Chemistry in a Post Covid-19 Classroom

Nwoji Ijeoma Hope Nonyelum[1], Cliff I. Okebanama[2]*, Iroanya Roseline Obiageli[3], & Onah Anthonia Ebere[4]

1,4.Department of Science Education, University of Nigeria Nsukka.
2,3.Federal College of Education (Technical) Potiscum.
*Corresponding Author Email: cliff.okebanama@unn.edu.ng

Abstract

Effective application of teaching methods is very vital in any teaching-learning situation, even in this post-COVID -19 classroom. The method adopted by the teacher may promote or hinder learning. This study focused on the optimization effects of flipped demonstration on academic achievement and retention of senior secondary school students in chemistry in a post-COVTD -19 classroom. A quasi-experimental design, using pre - test and post - test was adopted for the study. The sample consisted of eighty (80) senior secondary one (SSI) students from two secondary schools in Nsukka Education Zone of Enugu State selected through purposive random sampling. Four research questions and four null hypotheses tested at 0.05 level of significance guided the study. A twenty (20) item chemistry achievement test (CAT) and chemistry retention test (CRT) in the form of multiple-choice objective questions were used as instruments for data collection. Data collected were analyzed using mean and standard deviation for the research questions. Analysis of Covariance (ANCOVA) was used to test the null hypotheses at the P< 0.05 level of significance. The findings of the study were; there is a significant difference in the mean achievement scores of students taught chemistry using flipped demonstration method and those taught using the lecture method in favour of those taught using flipped demonstration method. The findings also indicated that flipped demonstration method is superior to the lecture method in promoting cognitive achievement in chemistry amongst students. Based on the findings, the following recommendation was made; chemistry teachers, science educators and curriculum planners should employ and incorporate the use of innovative methods and strategies such as flipped demonstration method in the classroom and into the various teacher education programmes.

Keywords: *Optimization, Flipped Demonstration Method, Academic Achievement, Retention, COVID-19 Classroom.*

INTRODUCTION

A classroom is a learning space in which both children and adults learn. The classroom provides a space where learning can take place uninterrupted by outside distraction. Post COVID-19 classroom is not a traditional classroom but a new normal to ensure the safety of students, educators and staff. Everything will look very different from classrooms, playgrounds and social spaces. In Post COVID-19 classroom, optimization is the act, process or methodology of making something (such as design, system, or decision) as fully perfect, functional, or effective as possible specifically (www.merriam -webster.com.optimi...).

The Flipped classroom is an instructional strategy and a type of blended learning that reverses the traditional learning environment by delivering instructional content outside classroom. It moves activities, including those that may have traditionally been considered

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

homework, into the classroom. In a flipped classroom student research at home and engage in concepts in the classroom with the guidance of a mentor (Abeysekera et al., 2015). Flipping the classroom means completely re - thinking how to do the job you have done in a certain way for years (Alvarez, 2011). It comes with some extra work. The flipped classroom model addresses how students learn best. We all know how hard it can be to stay focused during a long lecture, even if it is on a subject, we are especially interested in. Discussions and hands - on activities tend to keep students' interest. While you work with students directly as they employ the concepts they are learning in class, you can provide immediate feedback that helps them improve their learning as they go. Flipped classroom involves teachers who either create or link to content related instructional materials. Students do not learn at the same paces and in the same ways. That has always been a complicating factor teaching. The question of how to meet thirty or more unique students at their levels keeps teachers up at night.

The flipped classroom model gives teachers more opportunities to work directly with students. They can therefore clearly see when an individual student is having trouble with a concept and work with them directly to get through it. The increased interaction with students in the classroom will help teachers gain a clear idea of the different learning styles of their students so they can tailor their instruction to the needs of each one. Students can also work at their paces. The flipped classroom is a more evolved version of the student-centered classroom. It is about shifting from passive learning to active learning, in whatever way that works for you and your students (Nwoji & Atttah, 2019), Teaching methods comprises the principle and strategies used by teachers to enable students to learn. These strategies are determined partly by the subject matter to be taught and partly the nature of the learner. For a particular teaching method to be appropriate and efficient, it has to have a link with the characteristics of the learner and the type of learning it is supposed to bring about. The teaching approach is a way of looking at teaching and learning. An approach gives rise to method, the way of teaching with classroom activities or techniques to help learners learn. The approaches for teaching can be broadly classified into: a teacher-centered approach to learning and a student-centered approach to learning. In the teacher-centered approach to learning, teachers are mainly the authority figure in this model. Students are viewed as empty vessels whose primary role is to passively receives information. The primary role of the teacher is to pass knowledge and information to their students. Students learning is measured through objectively scored tests and assessments. In student-centered approach to learning, students are the authority figure in this model. Teachers and students play an equally active role in the learning process. The teacher’s primary role is a coach and facilitates the students learning and overall comprehension of the material. Students learning is measured through both the formal and informal assessments including group projects, class presentations and discussions (Ezeme & Ezeagbo, 2019)

In any learning environment, determining the method of instruction to use can be difficult because there are several instructional methods. Each method of instruction has its advantages and disadvantages. The methods of instruction include collaboration method, debriefing method, discussion method, demonstration method, lecture method, although this study will focus on the effect of flipped demonstration and lecture methods. The lecture method is for institutions with large classroom size, the lecture method gives the instructor or teacher chances to expose students to unpublished and not readily available materials, and students play a passive role which may hinder learning. The demonstration method is also called the coaching style or the lecture-cum –demonstration method. It is a process of teaching through examples or experiments. A demonstration may be used to prove a fact through a combination of visual evidence and associated reasoning. One of the advantages of the demonstration method

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

involves the capacity to include different forms of instructional materials to make the learning process engaging.

In addition to teaching methods, another variable that may interfere with students' achievement is gender. Gender refers to the amount of masculinity and feminists found in human beings, the normal man has a preponderance of feminist (Bichi in Onah & Onwubuariri, 2018). Gender is a social term that is set to differentiate males and females in terms of their different roles and responsibilities. Akinsola and Igwe as cited by Onah and Onwubuariri (2018) believe that gender issue is a pertinent factor in an educational setting in Nigeria and could be a factor that leads to the low academic achievement of learners in chemistry as a science subject. In recent years, several types of research have been conducted on gender – related issues. Such studies suggested that by the age of eleven, many young stars demonstrated a sex – stereotyped behavior and attitude (Agboola & Oloyede, 2007). In this study an attempt was made at investigating if flipped demonstration method is gender – friendly or not.

Various instructional strategies that are activity – based have been advocated by chemistry educators. Some of them are -: inquiry/ discovery (Oloyede, 2010); cooperative learning (Effandi & enatin, 2007); computer- assisted learning (Oyelekan & Olorundara, 2011); concept mapping (Okonkwo, 2012); mind mapping (Okeke, 2011); and personalized instruction (Samuel, 2007). All these instructional strategies are models that have been considered to be effective in enhancing students' understanding and high academic achievement in chemistry. Senior secondary school chemistry teachers have been called upon to adopt them in place of the conventional method of teaching chemistry, thereby enhancing their academic achievement in chemistry.

Despite the emphasis on the use of contemporary and innovative instructional strategies, to enhance students' academic achievement in chemistry, three years (2007 – 2009) after the first cycle of the implementation of the new senior secondary school chemistry curriculum, the academic achievement of students in chemistry was below average in the West African Senior School Certificate Examination (WASSCE) conducted by the West African Examination Council (WAEC). Within the three years of the second cycle (2010 – 2012), the academic achievement of students in chemistry remained consistently low. The scenario is presented in Table 1(A):

Table 1(A): general enrolment and performance of students in WASSCE May/June chemistry examination for the 2007 – 2012

Year	No. Sat.	Distinction & Credit (A1 – C6)	%
2007	422681	194284	45.97
2008	456993	185949	44.44
2009	468546	204725	43.69
2010	465643	236059	50.70
2011	565692	280250	49.54
2012	627302	270570	43.13

Source: WAEC Test Development and Research Unit, Lagos, Nigeria,

Chemistry is a difficult subject because of its abstract nature. The poor academic achievement and retention of students in secondary school level chemistry have been sources of concern to education stake holders and government at different times. Most of the time poor academic achievement and retention are caused by poor teaching methods and lack of retention. Because of these, researchers in science education have always been researching for better

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

methods that will enhance students' academic achievement, promote their retention and bridge students' achievement and retention in chemistry. The problem of this study posed as a question in which teaching methods (flipped demonstration method and lecture method) would enhance students' achievement and promote retention in chemistry. The purpose of the study was to determine the effect of flipped demonstration and lecture methods of teaching on academic achievement and retention of students in chemistry. The following research questions guided the study:

1) What is the achievement mean scores of students taught chemistry using flipped demonstration method and those taught using the lecture method?
2) What is the retention mean scores of students taught chemistry using flipped demonstration method and those taught using the lecture method?
3) What is the achievement mean scores of male and female students in chemistry?
4) What is the retention mean scores of male and female students in chemistry?

METHODOLOGY

The research design adopted for the study was a non-randomized control group quasi - experimental design. Specifically; the study adopted the pre-test and post- test non-randomized control group design. This study was carried out in Nsukka Local Government Area of Enugu State. The population of the study consisted of all the 3,942 SSI chemistry students in the 30-governrnent owned secondary schools in Nsukka Local Government Area of Enugu State. The sample size for this study was eighty (80) senior secondary class one (SSI) students obtained through a simple random sampling technique. Two schools were purposively selected and in each of the schools, two intact streams of SSI classes were randomly sampled, hence four classes altogether One class served as the experimental group while the other served as the control group for each school. The instrument used for data collection was a chemistry achievement test (CAT). The CAT consists of 20 multiple choice items adopted from the West African Examination Council (WAEC) past questions. The CAT was used for the pre-test, post-test and retention teat. The pre-test was given to gain a statistical baseline for both the experimental and control groups. The post-test was given after the students were taught The retention test was given a week after the students were taught to ascertain if they still remembered what they were taught The instrument was face- validated by two chemistry education experts and one measurement and evaluation expert, all in the Department of Science Education, University of Nigeria, Nsukka.

In order to determine the reliability of the instrument, CAT was pilot-tested on 40 **SSI** students that were not involved in the main study but were in the same geographical area. The reliability coefficient of the instrument was estimated using Kuder Richardson formula 20 (K-**R** 20) and the reliability coefficient of 0.832 was obtained.

An approval was sought from the principals of the various schools used for the study. The cooperation of the schools' chemistry teachers was also sought The researcher liaised with the classroom teachers to ensure intensive teaching of the topic "particulate nature of matter" which covers definition of matter, states of matter, physical and chemical changes. The students in the first school taught using flipped demonstration method of instruction which involves the use of adequate instructional resources / materials. After the teaching, a post- test was given to the students in order to find out if they have a good understanding of what they were taught. The students in the second school were taught using the lecture method of instruction. After

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

they were taught they were also given the same post-test that was administered on the first group. After one week of administering the test, the researcher went back to the various schools to administer the retention test, this helped the researcher to find out which group remembered what they had been taught The data from the pre-test (given before teaching), post-test and retention test were collected and kept. The scores obtained from the written tests were analyzed and used to answer the research questions used for the study. The period used for the study was four weeks. The research questions were answered using mean and standard deviation while the null hypotheses were tested at a 0.05 level of significance using Analysis of Covariance (ANCOVA)

RESULTS

Table 1 showed that the students that were taught chemistry using flipped demonstration method had an achievement mean score of 31.13 with a standard deviation of 4.50 at the post-test while those that were taught using the lecture method had an achievement mean score of 26.00 with a standard deviation of 8.21. Mean gain scores of 10. 85 and 1. 85 for the two groups respectively imply that the students that were exposed to flipped demonstration method seem to have achieved higher than their counterpart taught with the lecture method.

Table I: Mean and standard deviation of achievement scores of students taught chemistry using flipped demonstration method and those taught using lecture methods

Group	N	Pre-test		Post- test		
		Mean	SD	Mean	SD	Mean GAIN
Flipped Demonstration method	40	20.28	3.90	31.13	4 50	10.85
Lecture method	40	24.15	7.01	26.00	8.21	1.85

The analysis of data in Table 2 showed the retention mean scores of student's taught chemistry using flipped demonstration method and the lecture method respectively, it showed that the retention mean scores of students who were taught chemistry using flipped demonstration method is 58.88 against a pre- test score of 31.13 while those who were taught chemistry using the lecturer method had a retention mean score of 50.30 against a pre-test score of 26.00. Mean gain scores of 27.75 and 24.30 for the students who were exposed to flipped demonstration method and those exposed to the lecture method respectively might indicate that flipped demonstration method enhances the retention of students than the lecture method.

Table 2: Mean and standard deviation of retention scores of students taught chemistry using flipped demonstration method and those taught using the lecture method

Group	N	Pre-test		Post- Test		
		Mean	SD	Mean	SD	Mean GAIN
Flipped Demonstration method	40	31.13	4.50	58.88	6.85	27.75
Lecture method	40	26.00	8.21	50.30	7.63	24.30

The achievement mean scores of male and female students in chemistry are shown in Table 3. Male students had an achievement mean score of 27. 89 with a standard deviation of 7.49 at the post-test while their female counterparts had an achievement mean score of 29.19 with a standard deviation of 6.66, This indicates that female students achieved higher than their male counterparts.

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

Table 3: Mean and standard deviation of achievement scores of male and female students in chemistry

Group	N	Pre -test		Post- Test		
		Mean	SD	Mean	SD	Mean GAIN
Male	40	23.33	6.40	27.89	7.49	4.54
Female	40	21.15	7.01	29.19	6.66	8.04

For retention of content taught by gender, the retention mean scores of male and female students are the same, that is 57.59. The difference in the gain was a result of the differential achievement at the post-test.

Table 4: Mean and standard deviation of retention scores of male and female students in chemistry

Group	N	Post-test		Retention		
		Mean	SD	Mean	SD	Mean Gain
Male	40	27.89	7.49	57.59	7.11	29.70
Female	40	29.20	6.66	57.59	7.11	28.39

The analysis in Table 5 above showed that the probability associated with the calculated value of F (61.722) is 000. Since the probability value is 000 is less than the 0.05 level of significance. ($p<0.05$), the null hypothesis was rejected.

Hence, there is a significant difference in the achievement mean scores of students taught chemistry using flipped demonstration method and those taught using the lecture method in favour of those taught using flipped demonstration method. The students taught with flipped demonstration method achieved significantly higher than students taught with the lecture method.

Table 5: Analysis of covariance (ANCOVA) of the effects of flipped demonstration method and the lecture method on students' achievement in chemistry

Sources	Type 111 Sum of squares	Df	Mean square	F	Sig	Decision
Corrected Model	2579.856	4	644.964	35.468	000	
Intercept	708.742	1	708.742	38.975	000	
Pre- test	1960.501	1	1960.501	107.812	000	
Group	1122.371	1	1122.371	61.722	000	S
Gender	51.142	1	51.142	2.812	098	NS
Group gender	1.069	1	1.069	0.59	809	NS
Error	1363.832	75	18.184			
Total	69209.000	80				
Corrected total	3943.688	79				

R squared =654 (Adjusted R squared =636) S =Significant, NS = Not significant.

Table 6 showed that the probability associated with the calculated value of F (2.966) for the effect of the teaching method on students' retention is 089.

Since the probability value is greater than 0.05 level of significance (p 0.05), the null hypothesis was accepted indicating that there is no significant difference in the retention mean scores of students taught chemistry using flipped demonstration method and those taught using the lecture method.

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

Table 6: Analysis of covariance (ANCOVA) of the effects of flipped demonstration method and the lecture method on students' retention in chemistry

Sources	Type111Sumof squares	Df	Mean squares	F	Sig	Decision
Corrected	227.408	4	56.651	1.063	381	
Intercept	13783.695	1	13783.895	257.676	000	
Post-test	27.224	1	27.224	509	478	
Group	158.639	1	158.639	2.966	089	NS
Gender	3.378	1	3.378	063	802	NS
Group*						
Gender	48.985	1	48.985	916	342	
Error	4011.982	75	53.493			
Total	**269545.000**	**80**				
Corrected Total	**4239.388**	**79**				

Table 5 showed that the calculated value of F (2.812) for the influence of gender in students' achievement in chemistry is 098. This implies that gender is not a significant factor in the students' achievement in chemistry since P is greater than 0.05. Analysis of data in table 6 showed that the calculated value (063) for the influence of gender on students' retention mean score has a probability value of 802. For the fact that the probability value is greater than the 0. 05 level of significance, the null hypothesis was accepted. Thus, there is no significant difference in the retention mean scores of male and female students in chemistry.

DISCUSSION

In order to determine the effect of flipped demonstration method and the lecture method of teaching on students' achievement in chemistry, two groups of students were taught the topic "matter". During the teaching, a group of students were taught matter using flipped demonstration method while the other group of students was taught using lecture method. At the end of the teaching, the two groups already given pre-test were given post-test The scores obtained from the groups were analyzed The findings of the study showed that the students that were taught using flipped demonstration method achieved higher than those that were taught using lecture method. Further analysis showed that there is significant difference in the achievement mean scores of the students taught using flipped demonstration method and that taught using lecture method in favour of those taught using flipped demonstration method. This result is in agreement with the opinion of Agboola and Oloyede (2007) where it was established that there was a significant effect on students taught chemistry using project and inquiry teaching methods and students taught using the lecture method.

The retention ability of students in matter was investigated using two teaching methods. It was observed that the students who were exposed to flipped demonstration method had higher retention of the concept taught than those exposed to the lecture method. It was further confirmed that there is no significant difference in the retention mean scores of students taught using flipped demonstration method and those taught using the lecture method. This implied that the retention ability of students does not depend on any of the two teaching methods (flipped demonstration and the lecture method. The findings of the study showed that achievement mean scores of female students in chemistry were higher than those of the male students. However, further analysis showed that gender is not a significant factor in students' achievement in chemistry. The difference in the achievement scores of male and female students must have occurred as a result of the chance factor.

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

The findings of the study concerning the influence of gender on students' retention in chemistry showed that the retention scores of male and female students were the same. Moreover, it was confirmed that there is no significant difference in the retention mean scores of male and female students in chemistry. .

CONCLUSION

Based on the findings of the study, the researcher concluded that when students are taught chemistry with flipped demonstration method, they are bound to perform better, the teachers of chemistry now must put this into action to enhance the performance of students. The findings of the study imply that both flipped demonstration method and the lecture method improve the retention ability of the students in chemistry. Hence the two methods can be used ***to*** improve the retention of students in chemistry concepts. The findings of the study also imply that flipped demonstration method tends to promote homogeneity of performance between male and female students. In other words, the flipped demonstration method is gender-friendly. The chemistry teachers should try as much as possible to key into the use of flipped demonstration method of ***teaching*** chemistry during the classroom instructional delivery. Science teachers and curriculum planners should incorporate innovative strategies such as flipped demonstration method into their various teacher education programmes.

References

1) Abeysekera, Lakmai and Philip Dawson (2015). "Motivation and Cognitive load in the flipped classroom: definition, rationale and a call for research**. *Higher Education Research and Development,* 34(1), 1- 14.

2) Adesoji F. A. & Babatunde, A. G. (2008). Investigating gender difficulties and misconceptions in inorganic chemistry at the senior secondary school level. *International Journal of African and African-American studies.* Vii (1), 1-7.

3) Agboola, 0. S. and Oloyede, E. 0 (2007). Effect of Project, Inquiry and lecture-demonstration teaching methods on senior secondary students' achievement in separation of mixtures practical test. *Educational Research and Review,* 2(6), 124-126.

4) Ahiakwo, M. J. (1998). Cognitive style and students' problem-solving behavior in chemistry. Unpublished Ph.D thesis. Department of Teacher Education, University of Ibadan.

5) Alvarez, B. (2011). "Flipping the classroom: Homework, Lesson at home" *Education Digest: Essential Readings Condensed for Quick Review,* 77(8), 18-21.

6) Chikuni B (2003). The teachers' handbook. *A practical* ***approach*** *to teaching.* Gwanda, Flame Publishers

7) Erdem, E. (2012). Examination of the Effects of Project Based Learning Approach on Students Attitudes towards Chemistry and Test Anxiety, World Applied Sciences Journal, 17(6), 754 -764.

8) Eze, M. O, (2022), Effect of Demonstration Teaching Method on Students' Academic Achievement in Chemistry. Unpublished undergraduate project, Nsukka, University of Nigeria.

Volume 65 | Issue 04 | April 2026
DOI: 10.5281/zenodo.19551349

9) Ezeudu, F. 0 and Obi, T.N (2013), Effect of gender and location on students' achievement in Chemistry in Secondary School in Nsukka Local Government Area of Enugu State. Research in Humanities Social Science, 3(5), 50 -55.

10) Ezeme, L.C and Ezeagbo, F. G.(2019), The Effects of Demonstration and Lecture Methods on Academic Achievement and Retention of Senior Secondary School Students in Chemistry. Unpublished undergraduate project. Nsukka, University of Nigeria.

11) Nwoji, I. H. N and Attah, F. O. (2019), Effect of Flipped Demonstration Method on Senior Secondary School Students' Achievement in Chemistry, 60th Annual Conference Proceedings of Science Teachers Association of Nigeria. 446 – 452.

12) Onah, J. C and Onwubuariri, P. C. (2018). Effects of demonstration and lecture teaching methods on senior secondary school students 'achievement in chemistry. Unpublished undergraduate project, Nsukka, University of Nigeria

13) Shymansky, J. A. and Kyle, W. C. (2008), Learning and the learner. Science Education, 72(3), 293 -304.