EFFECT OF FLIPPED CLASSROOM INSTRUCTIONAL METHOD ON UPPER BASIC SCIENCE STUDENTS' ACADEMIC ACHIEVEMENT

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Abstract
The study investigated the effect of Flipped classroom instructional method on upper basic two (junior secondary school two) students' achievement in Basic Science. The study adopted a quasi-experimental control design, specifically the pre-test post-test non-equivalent control group design. Two research questions were posed and one hypothesis formulated to guide the study which was carried out in 2 schools in Owerri Municipal Council Area in Owerri Educational Zone2 of Imo State. Eighty-seven (87) JSS two students were used for the study. The study is a quasi- experimental study which employed pretest posttest control design and a 2x1 factorial design. Instrument used for data collection was Basic Science Achievement Test (BSAT) developed by the researchers. SSAT was validated by three experts and the reliability coefficient using Kuder Richardson (KR-20) was found to be 0.79. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) statistics was used to test the hypothesis at o.o5 significance level. The result revealed that method was a significant factor on students' achievement in Basic science. Thus, it was confirmed that students taught Basic Science using Flipped classroom instructional method performed better than those taught using the lecture method. It was recommended among others things that efforts should be made by curriculum experts to incorporate Flipped classroom teaching strategy into the teaching of Basic science.

Keywords: *Flipped classroom Basic science education, Upper basic, Academic achievement*

Introduction

Basic education is the base upon which other levels of education are made and requisite for human and national progress. It is central to human and national development. Basic education in Nigeria is the education that encompasses all levels of education exposed to a child from the sixth-year primary school to the end of the third-year of the junior secondary school at the formal school level. In the non-formal, it includes basic functional literacy and post-literacy programmes pre-arranged for children, youths and adults who are out-of-school. The National Policy on Education (FRN, 2013), sees basic education, as the education targeted at every child for free, universal and compulsory basic education irrespective of age, sex, ethnic or religious backgrounds, language or status. Sambo & Utin, (2015) stated that basic education in Nigeria was designed to eradicate illiteracy, enhanced effective communication skills in pupils, enlightens young learners on their rights, improve the learning skills of young learners on key subjects that would be of unlimited significance to them in the future. She further added that, basic education in Nigeria is also meant to educate pupils on healthy habits that would prevent sickness and any form of disease. It positively impacts on democracy, human rights, governance and political stability through increased understanding of non-violent ways to solve problems and mutual understanding between groups in conflict. Basic education ensures economic growth through increased creativity and productivity of individuals. This positively contributes to the economic growth of the nation. In a nut shell basic education is meant to promote the stimulation and acceleration of national development, political consciousness and national integration.

The task of actualizing qualitative basic education is the responsibility of all: the Federal Government, Non-Governmental Oganisations, communities and even individuals. The Federal Government through its Universal Basic Education Board provides free universal basic education for every Nigerian child of school-going age, out-of-school children, adolescents, and adults. Government ensures that the education is of quality numerical skills, effective literacy, communication and life skills, as well as ethical, moral, civic values and basically of societal relevance. Non-Governmental Organisations, communities and individual also help by donating materials and infrastructural facilities to schools and encouraging increase in school enrolment and qualitative education through active participation and collaboration with school administrators and the relevant educational agencies.

The philosophy of the basic education curriculum is that every learner who has gone through 9-years of basic education should have acquired appropriate levels of literacy, numeracy, manipulative and life skills; as well as the ethical, moral, and civic values needed for laying a solid foundation for lifelong learning as a basis for scientific and reflective thinking. No matter how articulate the philosophy of Nigerian basic education may be, it may not be effectively achieved if its products are not well grounded in basic science because basic sciences provide the prerequisite scientific knowledge, attitudes and skills upon which subsequent scientific and technological advancement is based (FRN, 2013). The general objective of basic science and technology education is to enable pupils to observe and explore the environment using their senses and hands. The objectives are specifically aimed to enable the learners to:

a.   develop interest in science and technology,
b.   acquire basic knowledge and skill in science and technology,
c.   apply their scientific and technological knowledge and skill to meet their societal needs,
d.   take advantage of the numerous career opportunities offered by science and technology and become prepared for further studies in science and technology (Nigeria Educational Research Development Council, 2007).

These objectives are enshrined in the Basic Science and Technology curriculum, derived from the National Policy on Education. Sambo and Utin (2015) opined that science contributes to the quality of life in such areas as health, nutrition, agriculture, transportation, material and energy production, and industrial development. They were of the opinion that since science and technology form the bedrock of sustainable development, that Basic Science should be given prominence in Nigerian schools. Researchers are of the opinion that the adoption of scientific frame of mind is a prerequisite for development (Adeyegbe, 2004; Adikwu, 2008 & Nwachukwu, 2008): as science education is a purveyor of sustainable development worldwide. In addition, science is of great importance to rapid economic and technological growth.

Basic Science education is an important driver for science driven sustainable development but what is worrisome is that numerous empirical studies (Betiku, 2001; Omole, 2003, and Ogunnika (2018) have concluded that students' academic achievement in Basic science in Nigeria was poor and needed enhancement. The poor achievement in basic sciences has alarmed stakeholders in science education. Abonyi and Ibe (2014) also noted poor

academic achievement in Basic Science in the studies they carried out. Similarly, Nwachukwu (2008) asserts that the cause for under development in Nigeria is based on substandard position of her science education, specifically in the primary and junior secondary schools. He also lamented that relevant statistical details on Basic Science showed that there is a great challenge in the area of science teaching.

Numerous causes have been acknowledged as the reasons for poor performance on the academic achievement of students in schools. These include school- teacher-related characteristics, teaching methods, social incentives, and a host of others (Abonyi and Ibe, 2014; Sambo and Utin, 2015) were of the opinion that poor methods and strategies of teaching are the major cause of poor academic achievement in Basic Science. Some other researchers like Mandor (2002), Ezema (2004) and Ekon (2013) have also indicated from their findings that one of the major causes of students' failure in Basic Science was lack of effective teaching methods.

Teaching methods are used by teachers to make the learning environment and to lay down the nature of the activity in which the teacher and the learner will be involved during the instructional delivery process. It is principally a sketch of learning objective-oriented activities and the flow of information between the teacher and the learner(s). Ogbu, Ugonna and Nwachukwu (2021) categorized teaching methods into two approaches; namely; teacher centered approach and student- centered approach. The national policy on education advocates for student-centered and activity-oriented approach, as such approach accelerates active learning of science subjects in schools at all level. Also, it has been noted that effective teaching may facilitate learning and make it more meaningful. In line with this statement, Ogbu (2018) echoes that effective teaching helps the learner to learn better, whereas poor teaching method would obviously lead to poor learning and, consequently, poor achievement.

Researchers and educators have investigated several strategies and teaching methods that will help students participate effectively in the teaching-learning process and to inspire them to study prior to class study time. The flipped classroom is one of several teaching strategies that is believed to efficiently help students to study and motivate them to study before the actual teaching starts especially in Basic Science (Demiralay, 2014, Zengin, 2017; Odo and Eze 2017). The flip classroom is an innovative instructional method. It is a type of blended learning where traditional face-to-face teaching is reversed.

In flipped classroom, the classroom-based activities like laboratory activities, problem solving, group work, and so on are taught using traditional methods through flipping the procedure of making related homework outside the learning environment (Roehl, Reddy and Shannon, 2013). Flipped classroom is also a blend of technology and student-centered learning. It is a teaching method that increases classroom and out-of-class productivity. The flipped classroom is structured on constructivist learning theory (Zengin, 2017). In this theory, learners construct their own meaning based on their prior knowledge. The students are actively involved in the learning process. In this process, instead of giving direct information to learners, an enabling and appropriate learning environment is created for learners to reconstruct and develop their knowledge (Ogbu, 2018). The out-of-class learning process in flipped classroom is based completely on self-regulated learning.

In flipped classroom, students learnt at home through engaging on content knowledge, tasks and exercises given to them by their teacher and exposed to the assignment model at school (Demiralay, 2014). The flipped classroom is different from the traditional face-to-face learning method in the sense that students learn their lessons whenever and wherever they want before coming to school. Consequently, teachers usually prepare their lesson contents through digital materials and support their students to access these materials prior to lessons. With this, students access the related lesson contents with their teachers' instructions. The contents are made available to them before lessons. Challenging, abstruse, difficult issues that cannot be adequately internalized are noted and posed to teachers and peers through face-to-face contact or through electronic medium. Also, with this process the flipped classroom addresses students' cognitive differences as individual students can learn at their own pace.

Several studies have indicated the positive effect of flipped classroom on students' academic achievement. Baepler, Walker and Driessen (2014) applied the flipped classroom model to a chemistry class and investigated the effect of gender on decreasing the sitting time inside a conventional amphitheater lecture hall. The findings of the study showed that learning outcomes were achieved by students at least as good as in the traditional classroom but gender had no significant influence on students' achievement in Chemistry and their decreasing seat time inside a conventional amphitheater hall. Butt (2014) studied a flipped classroom approach by inverting classroom materials with after-class materials of a final year actuarial course. Student views were obtained at the start and end of the semester regarding the flipped

classroom structure. At the end of the study, it was found that there was a significantly positive change in student views of the flipped classroom approach. Hung (2015) examined the possible impacts of flipping the classroom on English language learners' academic performance, learning attitudes and participation levels. Three different formats of flipped teaching were applied and it was found that the structured and semi-structured flipped lessons became more effective than the non-flipped lessons.

In Nigeria, Balaban, (2016) stated in his findings that the flipped classroom instructional format enhances learners' achievement than traditional method when taught the principles of economics course. Furthermore, Odo and Eze, (2017) stated in their findings that students exposed to computer science in tertiary institution using Flipped classroom method achieved higher than those taught with traditional method. It is seen from the above literature that studies on effect of Flipped classroom on students' academic achievement on different fields abound. However, the study on Upper Basic 2 students' academic achievement in Owerri Municipal Council is lacking. It is on this basis, that the researchers investigated the effect of Flipped classroom on academic achievement of students in basic science in Owerri Municipal Council.

The general purpose of the study was to determine the effect of Flipped classroom instructional method on Upper Basic two (JSS2) students' achievement in Basic Science. Specifically, the study intended to determine the effect of Flipped classroom instructional strategy on JS2 students' achievement in Basic science. The inclusion of gender as a moderator variable was to determine any differences that may be attributed to it in the study.

The following research questions guided the work:
1.   What is the difference between Flipped classroom strategy and lecture teaching method on upper basic two students' post-test achievement scores in Basic science?
2.   What is the difference between the post-test mean scores of male and female Upper Basdic two students taught Basic Science using Flipped classroom and lecture method in BSAT?

A hypothesis, tested at 0.05 level of significance was formulated for the study:
H$_{01}$: There is no significant difference in the Post-test mean achievement scores of Upper Basic two students taught Basic Science using Flipped classroom and those taught with Lecture methods.

Method

The study adopted the quasi-experimental design. Specifically, it used pre-test, post-test, non-equivalent control group design. The use of the design was justified by the fact that intact classes that were not equivalent were used.

The population of this study consisted all the (JSS2) Upper basic schools in Owerri Municipal Council of Imo State, totaling 2,431 students (two thousand, four hundred and thirty-one) in the 2019/2020 academic session, (Imo State Universal Basic Education Board,2021).

The sample consisted of eighty-seven students; one class from each of the 2 schools purposively selected out of the seventeen (17) Government owned Upper Basic schools in Owerri Municipal Council. The classes' population distribution was 43, and 44. In each school, one intact class was used. The experimental sample (43 students) while the control sample (44 students).

Basic Science Achievement Test (BSAT) was used for data collection. The BSAT is a 20-item multiple test, developed by the researcher using Upper basic 2 past question papers and Basic Science text books. The contents taught in the lessons were derived from upper basic 2 Basic science curriculum.

The research instruments alongside with the purpose of the study, research questions, research hypothesis and lesson plans were face validated by two experts in the Department of Measurement and Evaluation and two experts from Department of Curriculum Studies (Science background), School of Education, Michael Okpara University of Agriculture, Umudike. The instrument was subjected to trial testing outside the study area. Kuder Richardson (KR-20) was used to determine the reliability of the Basic Science Achievement Test which was 0.79.

Two instructional approaches were employed for this study. The first approach was the use of Flipped classroom instructional method while the second was the Lecture method. The two approaches were identical in terms of content coverage, time and mode of evaluation. The only difference was in instructional activities where Flipped classroom instructional strategy deviated from Lecture approach by the reversal mode of its instructional delivery activities and engagement of constructivist principles and theories during instructional process. Flipped classroom was used for the experimental (treatment group) while the lecture method was used for the control group. BSAT was administered to the entire groups as a pre-test before the treatment

commenced and as a post-test at the end of the treatment. The teaching lasted for four weeks. After the completion of the teaching of the Basic Science, BSAT was again re-administered (the paper colour of the BSAT was changed). The researcher carried out the task of administering of the achievement test both at the pretest and posttest.

The first period of the first week was used in grouping the intact classes into treatments A and B, administration of pre-test and commencement of actual teaching for the two groups. At the end of the 4th weeks post-test was administered to the two groups. Basic Science lessons were taught by the researchers to group A based on the lesson format prepared, and with the Flipped classroom instructional strategy. Group B was also taught by the researchers based on the same Basic Science lesson plans but with Lecture method. The same upper basic two Basic Science scheme of work was used for all the groups. The scores obtained from the pre-test and post-test were Analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was employed for testing the hypothesis. Results obtained from the analyzed data were presented below based on the research questions and hypothesis.

Results

Table 1: Post-test mean scores and Standard deviation scores of Students in Basic Science when taught using Flipped Classroom method and Lecture method

Teaching Method/Strategy	Number of Students	Type of Tests				Mean Gains
		Pre-test		Post test		
		$\bar{X}$	SD	$\bar{X}$	SD	
Flipped C. Strategy	43	19.03	7.41	41.87	9.02	22.84
Lecture Method	44	18.44	6.11	28.41	5.26	9.97

The data presented on Table 1 indicated that students taught Basic Science using Flipped classroom method had a mean score of 19.03 and a standard deviation of 7.41 in the pre-test and a mean of 41.87 and a standard deviation of 9.02 in the post-test with a pre-test post-test gain of 22. 84. The data also showed students taught using the Lecture method had a mean score of 18.44 and a standard deviation of 6.11 in the pre-test and a mean score of 28.41 and a standard deviation of 5.26 in the post test, making a pre-test posttest gain to be 9.97.

Table 2: Post –test mean achievement score and Standard deviation scores of Students in Basic Science achievement test due to teaching methods and gender

Teaching method/ Strategy	Types of test	Gender							
		Male				**Female**			
		No. of Student			**Mean gain**	**No. of students**			**Mean gain**
			$\bar{X}$	S.D			$\bar{X}$	S.D	
Flipped.C Strategy	Pretest	18	18.69	7.06	22.43	25	18.86	5.44	
	Post-test	18	41.12	8.88		24	42.98	8.54.87	24.12
Lecture method	Pretest	21	16.67	5.31		23	17.39	6.19	
	Post-test	21	27.87	5.03	9.02	23	27.98	5.03	10.59

The data presented in the Table 2 indicated that the male students in the Flipped classroom experimental group had a mean score of 18.69 and a standard deviation of 7.06 in the pre-test while in the post-test, the males scored a mean score of 41.12 and a standard deviation of 8.88 with achievement mean score of 22.43. The result also shows that the female students in the Flipped classroom experimental group had a mean score of 18.86 and a standard deviation of 5.44 in the pre-test of experimental group which is higher than that of male students in the post-test of the experimental group, with mean achievement score of 24.12 which is higher than that of the male students in the post-test score in the Flipped classroom experimental group.

The data presented on Table 2 also indicated that male students had a mean score of 16.69 and a standard deviation of 5.31, with mean achievement gain of 9.02 in the pre-test of the control group which was lower than the pre-test of the experimental group, while in the post-test, the male students had a mean score of 27.87 and a standard deviation of 5.03 which was lower than the experimental group. The result also shows that the female students had a mean score of 17.39 and a standard deviation of 6.19 in the pre-test of the control group which is higher than that of the male students score in the pre-test of the control group, while the female students had a mean score of 27.98 and a standard deviation of 5.03 with achievement gain of 10.59 which is high than that of the male students in the post-test of the control group.

Table 3: Analysis of Covariance (ANCOVA) for Basic Science Test mean achievement scores of students when taught using Flipped classroom teaching strategy and lecture teaching method

Sources of Variation	Type II sum of square	Df.	Mean sum of square	F.	Significance
Correlated model	5952.991[a]	2	2966.496	132.590	.000
Intercept	3674.011	1	3674.011	163.662	.000
Pre-test	408.541	C	408.541	18.199	.000
Teaching strategy/ method	4886.773	1	4886.773	217.685	.000
Error	1728.559	84	22.411		
Total	86684.000	87			
Corrected total	7681.550				

a. R square = .786 (adjusted R squared = 0.787)

The data on Table 3 show that the teaching methods (Flipped classroom and Lecture method) are significant factors in the mean achievement scores of the students in the Basic Science Achievement Test, because the p-value of 0.00 is less than 0.05. This result rejects the null hypothesis which states that there is no significant difference between the mean achievement scores of students in Basic Science Achievement Test when taught using the Flipped classroom and lecture method. It implies that there was a significant difference between the mean achievement scores of students in Basic Science Achievement Test when taught using the Flipped classroom teaching strategy and Lecture teaching method.

Discussion
The research findings based on the data presented are interpreted and discussed below:

Result from Table 1 showed the effects of teaching methods on students' achievement in Basic Science and that the mean achievement scores of the students in the experimental group were higher than those of the mean achievement scores of students in the control group. This result revealed that method was a significant factor on students' achievement in Basic Science. Thus, it has confirmed that students taught Basic Science using Flipped classroom instructional method performed better than those taught using the lecture method. The finding of this study seems to support the findings of previous studies (Hung, 2015; &Balaban,2016 & Odo and Eze, 2019) that

confirmed that the use of Flipped classroom teaching method leads to students' improved achievement in economics and Computer science. This was further confirmed by the result in Table 2, the data revealed that statistically gender is not a significant factor in academic achievement of male and female students taught Basic Science with Flipped classroom and Lecture method. The finding is consistent with Baepler et al (2014). They found that gender did not play significant roles on students' academic achievement when taught with Flipped classroom teaching method. This may be as a result of some of the skills that are incorporated in Flipped classroom like facilitation of creative thinking through building on students' prior knowledge. Activating prior knowledge help both male and female students as logical sequencing of topics helps to present instructional materials in a more meaningful way and gives the students necessary guide to help them explore topics at their own pace, time and place.

Also, the data on Table 3 shows that the teaching method (Flipped classroom and Lecture method) is a significant factor in the mean achievement scores of the students in Basic Science Achievement Test. This indicates that the null hypotheses is rejected. This result is consistent with Enfield 2013; (See and Conry, 2014 ; Kim, Kim, Khera, Khera and Getman, 2014) earlier argument that in Flipped classroom students are stimulated to move out of the classroom to learn anytime and anywhere and encourage to work together on significant ideas, under well-organized guidance which provides sufficient time for the completion of assignments, promoting students to build a learning community.

Conclusion
This study was carried out to investigate the effect of Flipped classroom instructional method on Upper Basic students' academic achievement in Basic Science. The result of the study shows that students exposed to Flipped classroom instructional method had higher mean academic achievement score gain than their peers exposed to lecture method of teaching. That is to say that Flipped instructional method enhances students' academic achievement.

Recommendations
Based on the findings of the study, the following recommendations were made:
1.   Efforts should be made by curriculum expert to incorporate Flipped classroom method in to teaching in upper basic schools. There should be a review in the current instructional procedure to accommodate Flipped

classroom method in upper basic teaching syllabus, so as to reduce the poor academic performance of students in Basic Science

2. Teaching with Flipped classroom is different from ordinary traditional teaching. As a result of this, Upper Basic teachers should be trained and versed on how best to develop and use Flipped Classroom method as to achieve its objective of enhancing achievement.

3. The result of this study underscores the need for Imo State Government through Secondary School Education Management Board (SCMB) to organized workshops for teachers to acquire and learn more effective teaching methods.

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