

# ENHANCING PRIMARY SCHOOL CHILDREN'S ACHIEVEMENT IN BASIC SCIENCE USING FLIPPED CLASSROOM: A CASE OF SIMPLE REPEATED MEASURES

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## Abstract

Over the years, there have been reports of poor performance of primary school children in Basic Science which is the foundation of science subjects at upper education levels. Teachers' use of traditional methods of teaching has been implicated for such poor performance of children in the subject. With the emergence of coronavirus disease 2019 (COVID-19), the mode of teaching shifted from the traditional face-to-face to the remote or online mode of teaching in most countries of the world. Based on the foregoing, the researchers explored the effectiveness of flipped classroom instructional approach on children's achievement in Basic Science using the simple repeated measures design. In this study, 31 primary three children participated in the six (6) weeks of treatment. Content and face validated Basic Science Achievement Test (BSAT) was used to collect data for the study. Before the commencement of the treatment, the children were pretested on two different occasions and after the treatment, were posttest two times. Thus, the multiple pre-testing and post-testing served as the control for the treatment (flipped classroom). Data collected were analysed using a mixed-design repeated-measures analysis of variance. The finding revealed that flipped classroom instructional approach significantly ( $p = 000$ ) enhanced children's achievement in Basic Science. This implies that flipped classroom instructional approach is very effective in the enhancement of children's achievement in Basic Science. It was thus, recommended that primary school teachers should adopt the use of flipped classroom instructional approach in teaching and learning Basic Science and other related subjects.

Keywords: Basic science, Enhancing, Flipped classroom, primary school children, Simple repeated measures.

## 1 INTRODUCTION

Over the years, there have been reports of poor performance of primary school children in Basic Science which is the foundation of science subjects at upper education levels [1] [2]. Teachers' use of traditional methods of teaching has been implicated for such poor performance of children in the subject. With the emergence of coronavirus disease 2019 (COVID-19), the mode of teaching shifted from the traditional face-to-face to the remote or online mode of teaching in most countries of the world. The emergence of coronavirus disease in 2019 (COVID-19) has brought drastic changes in the educational system across the globe. This has caused many schools especially in the developed country to adopt the online mode of teaching as a face-to-face mode of teaching was kept on hold to avoid the spread of COVID-19. However, there is evidence of most classrooms across the globe been dominated by lectures and text-based learning [3].

According to [4], the abrupt change as a result of COVID-19 has led to a general fear of a drop in the quality of education as a result of lack of physical interaction. Among the online educational approaches, flipped learning has received significant popularity in recent years [5]. Flipped classroom instructional approach reverses the traditional teaching method by asking students to do assignments or homework outside of the classroom through online media [6]. According to [3], there is well-documented evidence of the effectiveness of the flipped classroom approach across disciplines in both K-12 and higher education. The flipped classroom is a well-known teaching strategy for many science courses in most countries [7]. The flipped classroom in a nutshell is the inversion of conventional classroom procedures [7]. The flipped classroom is a student-centered learning approach that involves allowing the learners to complete pre-class work to obtain basic knowledge before the actual classroom activities [8]. In flipped classroom, pre-class activities comprise textbook, web-based, or literature readings or watching of videos of classroom lessons at a pace suitable to

their own learning needs [8]. Flipped learning as an innovative active learning approach provides students with several opportunities [9]. A lot of recent studies have been carried out on the effectiveness of flipped classroom on learners' achievement in different subject areas especially sciences.

The use of flipped classroom approach improved the performance of students in the English language [3]. There was a significant positive effect of the implementation of flipped classroom approach on academic achievement in Science classes [7]. [8] revealed that the use of flipped classroom is an effective and active learning strategy in a population of high school students. The use of flipped classroom approach significantly improved the interest of students in the learning of modules than those taught using the traditional teaching approach [10] [11]. Adding game elements into a flipped classroom had a significant effect on the students' better-learning performance, motivation, and participation [5]. Teachers' use of flipped classroom significantly improved students' academic achievement compared with the other classroom models [12].

Furthermore, students who were exposed to flipped courses significantly exhibited gains in critical thinking than their counterparts who were not so exposed [13]. In a sample of science students, flipped classroom significantly had an effect on the performance of the students better than their counterparts taught using the traditional lecture method [14]. Students' performance significantly improved as a result of the outcomes of flipped learning [9]. Flipped classroom approach significantly enhanced the students' performance and perceptions of an online open distance-learning environment [15].

The foregoing has ex-rayed the quality of research done on the effectiveness of flipped classroom approach on students learning outcomes. The different empirical evidence from the above research have proved the effectiveness of flipped classroom approach. However, most of those studies centered on high school and university students rather than the primary school children/pupils. Moreover, none of the reviewed studies was carried out in Nigeria. Thus, these gaps in literature necessitated this empirical research on the use of flipped classroom at the primary school level in the Nigerian context. This research aimed to explore the effectiveness of flipped classroom instructional approach on children's achievement in Basic Science in Nigeria. The researchers hypothesized that flipped classroom instructional approach had a significant ( $p < .05$ ) effect on children's achievement in Basic Science.

## **2 METHODOLOGY**

### **2.1 Research design**

This study adopted a simple repeated measures research design. This design involves the use of a single group of participants who are normally exposed to different test occasions before the commencement of the treatment and then subjected to different test occasions after the treatment. In this case, the different test occasions serve as the control to the treatment condition. This design has been used recently by [16] [17] in similar studies.

### **2.2 Participants**

A sample of 31 primary three pupils participated in this study. The participants were sampled from a population of primary three children in primary schools in Enugu state Nigeria. A purposive sampling technique was used to select children who have access to home technology such as computers and smartphones with internet facilities.

### **2.3 Measure**

The Basic Science Achievement Test (BSAT) developed by the researchers was used for data collection. BSAT is a 20-item multiple-choice test with options A, B, C, and D of which the children were expected to select the correct option for each of the questions. The items of the BSAT were generated from the primary three basic science scheme of work or curriculum. Any correct answer to a question attracted 2 marks implying minimum and maximum scores of 0 and 40 respectively.

## 2.4 Validation and reliability of the measure

The BSAT was faced validated by test development experts in the researchers' institutions. The experts were requested to facially look at the items of the BSAT concerning the wording of the items, suitability of the items to the research purpose, quality of the items, language used. After their validation verdicts, the BSAT was modified accordingly. Besides, the content validation of the BSAT was ensured using a Table of specifications which was also vetted by the experts. Thereafter, copies of the BSAT were administered on the equivalent group of children in a different location to ascertain the reliability of the items of BSAT. The data obtained from such administration were analysed using Kuder-Richardson formula 20 which yielded an internal consistency reliability index of 0.84. The estimate of the temporal stability of the BSAT was also determined by administering the copies of it at two weeks interval of the first administration. The data obtained in the two administrations were analysed using Pearson correlation which gave an index of 0.88.

## 2.5 Procedure

The researchers visited the schools used for the research to obtain written permission from the school headteachers prior to the commencement of the research. The children who participated in the research were also served with informed consent forms to fill and sign as a mark of their willingness to participate. Having done all those, the researchers scheduled for baseline assessments on two different occasions. Thus, the participants were given the items of BSAT to respond to on two different occasions before the actual treatment started. On each of the occasions, the children were allowed to respond to the items of BSAT in a space of 40 minutes. Thereafter, the treatment commenced. The participants were exposed to a 6-week treatment condition using flipped classroom instructional approach. The contents of Basic science the participants were exposed are concepts of matter, work, energy, power, and electricity. The participants were provided online materials on those concepts to study at home through an online platform and thereafter shared their experiences in the real classroom with the teacher as a moderator. This exercise lasted for 6 weeks after which posttests were administered to the participants on two different occasions.

## 2.6 Ethical approval statement

The ethical approval for the conduct of this research was granted by the University of Nigerian committee on research ethics.

## 2.7 Data analysis

Data collected from the four different test occasions were analysed using mixed-design repeated measures analysis of variance. Mauchly's test of sphericity for the assumption of the sphericity of repeated measures ANOVA was not significant (Mauchly  $W = .859, p = .502$ ).

## 3 RESULTS

Table 1: Mean analysis of the achievement scores of the participants at four different test occasions.

<i>Test occasion</i>	<i>n</i>	<i>Mean</i>	<i>Std. Deviation</i>
Pretest 1	31	10.80	2.30
Pretest 2	31	11.03	2.46
Posttest 1	31	31.00	6.71
Posttest 2	31	33.12	4.54

Table 1 shows that the participants had mean achievement score of ( $M = 10.80, SD = 2.30$ ) at pre-test 1, mean achievement score of ( $M = 11.03, SD = 2.46$ ) at pre-test 2, mean achievement score of ( $M = 31.00, SD = 6.71$ ) at post-test 1 and mean achievement score of ( $M = 33.12, SD = 4.54$ ) at post-test 2.

Table 2: Repeated measures analysis of variance of the difference in the test occasions.

	Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared
Time	Sphericity Assumed	13931.702	3	4643.901	279.650	.000	.903
	Greenhouse-Geisser	13931.702	1.341	10392.780	279.650	.000	.903
	Huynh-Feldt	13931.702	1.380	10093.917	279.650	.000	.903
	Lower-bound	13931.702	1.000	13931.702	279.650	.000	.903
Error (Time)	Sphericity Assumed	1494.548	90	16.606			
	Greenhouse-Geisser	1494.548	40.216	37.163			
	Huynh-Feldt	1494.548	41.406	36.095			
	Lower-bound	1494.548	30.000	49.818			

Table 2 revealed that there is a significant difference in the mean achievement scores of the participants at different test occasions,  $F(3, 90) = 279.650$ ,  $p < .05$ ,  $\eta_p^2 = .903$ . The post hoc pairwise comparison for the significant difference in the mean achievement scores of the participants at different test occasions is shown in Table 3. Table 3 showed that the mean difference between test 4 and test 1 contributed most to the significant difference followed by the mean difference between test 4 and test 2. This indicates that flipped classroom had a significant effect on the achievement of pupils in Basic Science. Thus, the effect size of .903 indicates that 90.3% change in the achievement of pupils in Basic Science is attributed to the effect of the flipped classroom.

Table 3: Post-Hoc pairwise comparison test for the significant difference in the test occasions.

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
1	2	-.226	.285	.967	-1.028	.576
	3	-20.194 <sup>*</sup>	1.427	.000	-24.211	-16.176
	4	-22.323 <sup>*</sup>	.915	.000	-24.900	-19.746
2	1	.226	.285	.967	-.576	1.028
	3	-19.968 <sup>*</sup>	1.398	.000	-23.904	-16.032
	4	-22.097 <sup>*</sup>	.888	.000	-24.596	-19.597
3	1	20.194 <sup>*</sup>	1.427	.000	16.176	24.211
	2	19.968 <sup>*</sup>	1.398	.000	16.032	23.904
	4	-2.129	.856	.107	-4.540	.282
4	1	22.323 <sup>*</sup>	.915	.000	19.746	24.900
	2	22.097 <sup>*</sup>	.888	.000	19.597	24.596
	3	2.129	.856	.107	-.282	4.540

Based on estimated marginal means

\*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Sidak.

## 4 DISCUSSION OF THE RESULTS

This study sought to determine the effect of the flipped classroom on pupils' achievement in Basics Science using simple repeated measures design. The results of the analysis revealed that the mean achievement scores of the pupils improved significantly at posttest 1 and 2 respectively. This indicated that flipped classroom significantly improved the achievement of pupils in Basic Science. This result goes to show that the interactive nature of flipped classroom captivates the interest of the learners vis-à-vis their achievement in such engagement. A flipped classroom is learner-centered approach to

teaching in which learners are given materials to read or watch through an online platform unlike the traditional method of teaching where the teacher does everything. In flipped classroom, pre-class activities comprise textbook, web-based, or literature readings or watching of videos of classroom lessons at a pace suitable to their own learning needs [8]. Flipped learning as an innovative active learning approach provides students with several opportunities [9]. Several recent empirical studies have attested to the results of this research.

Teachers' use of flipped classroom significantly improved students' academic achievement compared with the other classroom models [12]. Flipped classroom approach significantly enhanced the students' performance and perceptions of an online open distance-learning environment [15]. In a sample of science students, flipped classroom significantly had an effect on the performance of the students better than their counterparts taught using the traditional lecture method [14]. Students' performance significantly improved as a result of the outcomes of flipped learning [9]. Students who were exposed to flipped courses significantly exhibited gains in critical thinking than their counterparts who were not so exposed [13]. Adding game elements into a flipped classroom had a significant effect on the students' better-learning performance, motivation, and participation [5]. The use of flipped classroom approach improved the performance of students in the English language [3]. There was a significant positive effect of the implementation of flipped classroom approach on academic achievement in Science classes [7]. [8] revealed that the use of flipped classroom is an effective and active learning strategy in a population of high school students.

This result has several implications for the teaching of science subjects. It has been verified that flipped classroom instructional approach enhances pupils' achievement in the Nigerian context. This implies that science teaching in the Nigerian context will greatly improve if teachers adopt the use of flipped classroom instructional approach to teaching. Also, pupils' interest and motivation in the learning of science can be enhanced when pupils are exposed to the use of flipped classroom approach.

## 5 CONCLUSION

Flipped classroom approach is an effective instructional approach to the teaching of Basic Science at the primary school level. It is, therefore, concluded that the use of flipped classroom instructional approach will significantly enhance the achievement of pupils in Basic Science. It is thus, recommended that teachers of Basic Science should adopt the use of flipped classroom instructional approach especially in the COVID-19 pandemic era. Also, adequate workshop/seminar should be organised by the Local Government Education Authority to enable teachers to acquire the requisite skills in the use of the flipped classroom.

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