EFFECT OF FLIPPED CLASSROOM ON STUDENTS' ACADEMIC PERFORMANCE IN PRACTICAL PHYSICS AMONGST SECONDARY SCHOOLS IN LAGOS STATE

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Abstract

This research aimed to examine students' academic performance in practical physics among secondary schools in Lagos state using the flipped classroom model. Quasi-experimental design was used. The participants in the research were one hundred senior secondary school (SS2) students. They were purposively selected and were assigned to the treatment and the control groups. Flipped classroom was implemented in the experimental group while conventional method was used in the control group. An achievement and aptitude test were conducted to get the pre-test post-test result and to observe the attitudinal change of the students towards learning of physics (practicals). The achievement and aptitude test instruments were put through face and content validity, likewise it reliability was tested and Cronbach's alpha value of 0.70 and 0.75 were recorded respectively. A pre-test and the post test score of both groups were collected and analyzed. It was discovered that there was no statistically significant difference in the pre-test score of the experimental group and the control group before the treatment. However it was noted that students in the experimental group had significantly higher performance after the treatment this was from their post-test score. Result revealed that flipped classroom yielded a positive effect on student academic performance in practical physics among secondary schools in Lagos state. This research will not only contribute to the improvement of academic performance of students in practical physics alone but to the entire field of education and the practice of teaching and learning at large.

Introduction

Communication, teamwork, problem-solving, creativity, and critical thinking are fundamental competencies for achievement in the twenty-first century Chan, Cheung and Lee (2017). Today's students, who are digital natives, have to be equipped with relevant competencies to respond to the demands of the modern world. For this reason, innovations in teaching–learning processes and instructional environments, which are essential to meet the needs of these learners, have brought active-learning pedagogy to the forefront of education. Active learning is necessary for students to take part in the learning process and to make their learning permanent (Canaleta et al. 2014; Niemi et al. 2016). An important constraint of education is that teachers cannot simply transmit knowledge to students; rather students need to construct knowledge actively in their own minds (Olusegun 2015; Thompson 2013).

The implementation of a flipped learning approach can take advantage of the increased occasions for constructivist teaching and learning that technology provides (Koohddang et al. 2009). Flipped learning has many potential benefits including more one-on-one interaction

time between teacher and students, active learning and cooperation, and self-paced learning. Also, it provides students with flexibility in the event that they miss some lectures. In addition, flipped learning can be considered complimentary to the traditional classroom setting because it encourages classroom time to be arranged more toward active and collaborative learning (Roach 2014). In recent years, flipped learning has been introduced to foster active learning in diverse educational contexts, including K-12 and higher education (Şahin and Fell-Kurban 2016; Hamdan et al. 2013). Since its first appearance in the classroom, discussions have frequently focused on the extent to which it is effective in student achievement.

Studies have been conducted to determine its effectiveness in this area (Chao et al. 2015; Davis et al. 2013; Hwang and Lai 2017; Mennella 2016; Gomez-Tejedor et al. 2020; Zainuddin and Halili 2016) and to determine the quality of interaction between students, teachers, and the content of lessons (Christiansen et al. 2017; Yildiz-Durak 2018; Winter 2018). Other studies have examined the relationship between student perception and achievement, while prediction studies have focused on the outcomes of academic achievement (Sletten 2017).

The flipped classroom model is a new and an innovative instructional model, where content presentation and traditional activities normally done in the classroom are given to students as homework, and traditional homework activities become classroom activities (Bergmann & Sams, 2012). In the flipped classroom, the teacher becomes a facilitator who helps students to actively engage with lesson contents instead of merely presenting lesson contents to students. Teachers involve learners in discussions, problem-solving and hands-on activities (Akçayır & Akçayır, 2018). The flipped classroom model has been implemented in schools and universities around the world in disciplines such as Mathematics, Social Sciences and Humanities (Hao, 2016). Research findings on the implementation of the flipped classroom model show improved learning experiences and performance of students. In addition to this, the model enhances student satisfaction, confidence, teamwork, engagement, and motivation; promotes creativity, increases problem-solving skills of learners and makes the learning process more fun in comparison to the traditional method of teaching and learning (Bergmann & Sams, 2012; Akçayır & Akçayır, 2018; Awidia & Paynterb, 2019).

This nature of the flipped model ensures that when it is implemented, the 21st-century skills of communication, innovation, creativity and collaboration are exhibited in the learning process. Thus, this instructional strategy is very needful and relevant for teaching and learning. In this regard, this research sought to find out the effect of flipped classroom on students' academic performance in practical physics among secondary school students in Lagos state Nigeria and teachers knowledge and usage of the flipped classroom model. According to Bergmann and Sams (2012) the concept of flipped classroom means what is done at home as a traditional learning is done during the classroom period, and what is done during the classroom period as a traditional learning, is done at home. Furthermore, the information of content is presented to the student outside the classroom period through technology tools such as video, which are created by teacher to explain a certain lesson or information related to the lesson.

Alzwekh (2014) mentioned that flipped classroom is a form of modern teaching methods that uses the advanced techniques smartly and funnily in order to meet the needs of students at the present time. In addition, the idea of flipped classroom is based upon flipping learning assignments between classroom and home by increasing

the role of effectiveness of modern technological tools in teaching and learning processes. DeLozier and Rhodes (2017) defined the flipped classroom as the teaching practice of teachers which occurs by assigning lectures outside of class and devoting class time to a variety of learning activities. In this practice, students are responsible for reviewing all prepared materials. In this model teachers prepare lessons through videos or any multimedia that the students can view at homes or in any other places by using their tablets or smart phones before attending the class, while the time of lecture is advocated for exercises, activities, practices and helping solve home assignments. The previous definitions point out that the concept of flipped classroom means flipping the processes of teaching and learning in the classroom and home by activating the role of modern technological tools in preparing and presenting lessons. That is, the teacher prepares the material in which he/she explains the new information/concept by using modern audio and visual multimedia, and reactive evaluation in order to be available for the student before starting the lesson. The role of teacher in this strategy is a mediator and a motivator of students to learn through the prepared materials before class time.

Research Objectives

The purpose of this research is investigate the effect of flipped classroom on the academic performance of student in practical physics. To reach the goal of our research we have established three research objectives.

1. To examine the academic performance of students in practical physics before their exposure to the flipped classroom strategy
2. To find out the effect of flipped classroom on students' academic performance in practical physics.
3. To investigate if there would be a significant difference in the academic performance of students taught using the flipped classroom strategy and their counterparts taught through the traditional method.

Statement of Problem

Flipped classroom is a trend that has gained momentum in recent years and is considered to be a quantum leap in how students absorb, process and retain information. This model of learning eliminates homework, rather it empowers students to collaborate and work on their tasks during class time having watched videos of the concept taught previously while at home.

It is observed that the attitude of senior secondary school students to physics practical courses is not encouraging. Likewise their performance at both school examination and external examinations (WASSCE) and (NECO SSCE) in the area of physics practical courses seems not to be good enough. To this end this research aimed at improving the performance of students in practical physics through the use of flipped classroom. Furthermore it sought to examine the effect of the flipped classroom model on the academic performance of senior secondary school students in Lagos State in the research of practical physics.

Research questions

The diversity of studies and results does not make it easy to judge the efficacy of flipped classroom. Apparently, the educational context and the way in which the method is applied play a major role in the way students learn and has effect on their overall performance. This research was conducted at four senior secondary schools in Ojo zone of Education District V of Lagos State, Nigeria. The goal is to examine the effects of flipped classroom when applied to practical physics course in secondary classes in Nigeria. The questions of interest are:

1. Is there a statistically significant difference in the academics performance of students in the

experimental and control group from their pre - test score?

2. Is there a statistically significant difference in the academic performance of students in the experimental and control group after their exposure to the flip classroom?

Research Hypotheses

Two research hypothesis were stated in this research

1. There is no statistically significant difference in the academic performance of students in the experimental group and the control group from their pre-test score result.
2. There is no statistically significant difference in the academic performance of students in the experimental group and the control group after their exposure to the flip classroom.

Related Literature and Theoretical Framework

Flipped classroom inverts traditional teaching methods by delivering direct instruction in online videos to be watched at home while typical homework activity is moved into the classroom. Introduced by Bergmann and Sams (2012), the key concept of flipped classroom is to free up class time for activities that allow deeper exploration of the content. Out of class, students watch pre-recorded videos and screencasts at their own pace and familiarize themselves with a new topic. In class, an active learning setting enables them to apply and consolidate their knowledge. By outsourcing lectures, the role of the teacher shifts from instructing to coaching the students.

The flipped classroom is an approach to teaching and learning that inverts the structure of the traditional classroom. It incorporates the constructivist learning theory which is based on the concept that learners construct their knowledge from prior experiences. In such learning situations, reinforcement takes place in the classroom with the teacher's guidance.

Cognitive performance outcome is not the only aspect leading to a teaching method. Other aspects like the development of knowledge-gaining competences, communication, and personal and self-competences are also important. The beliefs and attitudes that influence the development of cognitive and non-cognitive competences are motivation, interest and academic self-concept (Krapp, 1992; Trautwein and Möller, 2016). According to research, flipped classroom provides a framework in which these attitudes can improve (Bormann, 2014; González-Gómez, Jeong, Airado & Cañada-Cañada, 2016; Fautch, 2015).

Implementing Flipped Classroom Strategy

Asiksoy and Ozdamli (2016) demonstrated that flipped classroom approach is a type of student-centered approach. i.e., students could actively learn information of new lessons any time at home by watching recorded videos of such lessons either using their smart phones or computer devices such as IPads, laptops e.tc which are of great value and importance in achieving Flipped learning.

Those technology tools enable students to play back educational videos several times in order to understand the new information. In addition, it is possible to accelerate the educational videos to skip the parts that they are mastered in. Also, it is possible to take notes. By implementing flipped classroom strategy, the individual differences of students can be considered, performance can be improved, boredom will disappear, and excitement and learning enjoyment will increase.

After reviewing learning materials, students attend the physical environment of classroom readily to apply what they have learnt from the video clips. The teacher plays a vital role by guiding the students to perform the task rather than teaching them how to go about such tasks. The teacher presents the activity to be performed in the classroom,

instead of prioritizing classroom time in passive listening to the teacher's explanation.

Home assignments do not exist in the flipped classroom as students activities that are home assignments in the classroom.

Table 1

List of government approved secondary schools selected for the research and number of students from each school

S/N	Name of school	Educational District	Number of respondent selected
1	Stokhan Comprehensive college, Isashi Lagos	District V	25
2	Rocland Secondary School, Aiyetoro Lagos	District V	25
3	Golden Hallmark secondary Alasia Lagos	District V	25
4	Damtops International college Mowogbo Lagos	District V	25

Methodology

The quasi-experimental research design was adopted for this research, four Government Approved Private Schools in Ojo zone of Education District V of Lagos State were purposively selected for the research. These includes Schools that are government approved, WAEC/NECO accredited, the school involved also have well equipped laboratories with graduate physics teachers that have taught physics for not less than eight years. The control group comprises of 50 SS II physics students while the experimental group comprises of 50 SS II physics students. Four physics teachers with several years of teaching experience who had taught physics consistently in the last eight years were part of the research. The four teachers taught both the control and the experimental group alternatively for a period of eight weeks, this means that the treatment had a length of eight school weeks (16 lessons) two lessons per week. The content covered takes care of all branches of physics which includes: Mechanics, Heat, Optics and Electricity.

Population

The population for the research consists of all SS2 science students in Lagos state secondary schools offering physics.

Sample

The sample for this research consists of 100 SS2 science students selected across four government approved private secondary schools with WAEC/NECO accreditation.

Sampling Procedure

Purposive sampling was use to select the four government approved private secondary schools that have been participating in the West African Senior Secondary Examination in the last ten years, also one physics teacher was selected in each of these secondary schools, who holds a degree in physics and have been teaching the subject for the past eight years. Likewise 25 students were selected from each of the schools.

Instrumentation

Two research instruments were used in these studies, they include:

Physics Practical Achievement Test (PPAT)

Physics Practical Classified Aptitude Test (PPCAT)

Validity of the Instrument

The validity of an instrument is the soundness of such instrument in measuring what it is designed to measure, to this end, all instrument used in this research were subjected to face and content validity by giving it to senior colleagues of the researchers. All observation and corrections were effected before the administration of the instrument.

Reliability

Reliability refers to the extent to which an instrument yield the same results over multiple trials, as such the reliability of the instrument in this research were ascertain using a test re-test reliability format and a Chronbach's alpha of 0.75 was recorded.

Data Analyis

All data collected from the research were coded and analyzed using Statistical Package for Social Sciences (SPSS IBM 23). Mean. Standard Deviation and T-Test were used to ascertain distribution .of variables in the study and to determine the effect of flipped classroom on students' academic performance in practical physics.

They covered the entire content of the unit and showed recorded demonstrations of experiments, commented screencasts, and overview slides. The students were to watch the videos before class. At the beginning of each school lesson, a ten minute interactive clicker quiz with four concept questions served to assess the level of knowledge and facilitated student-student interaction in a peer education setting. Following the quiz, the students were given both mandatory and elective assignments with increasing level of difficulty to work on in pairs or groups. The students controlled their solutions in their own responsibility with sample solutions laid out. The role of the teachers was to provide an environment of active learning, to engage with students, to answer individual questions, and to give assistance in accordance to the students' needs.

Essential problems were frequently solved together on the board. By contrast, the conventional way of teaching the control group involved live experiments conducted by the teachers, plenary conversations in an inquiry-based learning setting, providing results on the board, and short problem-solving assignments in class. The students had to solve most of the assignments at home. At the beginning of the next lesson, the teacher and the students discussed the solutions of the homework. The teachers taught all courses of both the control and the treatment group synchronously and in close cooperation.

To assess the performance gain of each student, a content knowledge pre/post-test was used whereas the student related parameters were collected by a pre/post achievement test. The content knowledge test was a sample of modified problems from textbooks.

Result of Findings

Test of Hypotheses

Hypothesis One

There is no statistically significant difference in the academic performance of students in the experimental group and control group from their pre-test result.

Table 2: t-test analysis of difference in academic performance of students in the experimental group and control group from their pre-test result

Academic performance of students	N	Mean	Std. Deviation	t	p value	A	Remark
Experimental group	50	15.52	2.44				
Control group	50	15.60	2.52	-0.161	0.872	0.05	Not Significant

The results in Table 2 show that there is no statistically significant difference in the academic performance of students in the experimental group and control group from their pre-test result [$t_{(df = 48)} = -0.161$; $p > 0.05$]. The mean difference is not significant at 0.05 level. The mean values indicate that, non-significantly, academic performance of students are different between experimental group and control group in their pre-test result. Therefore, null hypothesis one, which states that there will be no statistically significant difference in the academic performance of students in the experimental group and control group from their pre-test result is not rejected. The implication is that academic performance of students in experimental group and control group is not significantly different from their pre-test result.

Hypothesis Two

There is no statistically significant difference in the academic performance of students in the experimental

group and control group after their exposure to the flipped classroom.

Table 3: t-test analysis of difference in academic performance of students in the experimental group and control group after their exposure to the flipped classroom

Academic performance of students	N	Mean	Std. Deviation	t	p value	α	Remark
experimental group	50	23.32	2.51	16.46	0.001	0.05	Significant
Control group	50	15.40	2.30				

The results in Table 3 show that there is a statistically significant difference in the academic performance of students in the experimental group and control group after their exposure to the flipped classroom [$t_{(df = 48)} = 16.46$; $p < 0.05$]. The mean difference is significant at 0.05 level. The mean values indicate that, significantly, academic performance of students are different between experimental group and control group after their exposure to the flipped classroom. Therefore, null hypothesis one, which states that there will be no statistically significant difference in the academic performance of students in the experimental group and control group after their exposure to the flipped classroom is rejected. The implication is that academic performance of students in experimental group and control group after their exposure to the flipped classroom is significantly different.

Table 4

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre-test Result	Experimental group	50	15.5200	2.44315	.34551
	Control group	50	15.6000	2.52336	.35686

Grouped statistics showing academic performance of students for test of hypothesis one

Table 5

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
Post-test Result	Experimental group	50	23.3200	2.51071	.35507
	Control group	50	15.4000	2.29463	.32451

Grouped statistics showing academic performance of students for test of hypothesis two

Discussion

From the result of this research, it was discovered that at 0.05 level of significance, 16.46; $p < 0.05$ the mean difference is significant. These mean values indicate that, significantly, academic performance of students are difference between the experimental and control group after their exposure to the flipped classroom. Flipped classroom practices increased the academic performance of students in practical physics statistically and significantly. This result is consistent with the results of numerous studies in the literature. Some of these studies were carried out in Physics courses, (Dursunlar, 2018; Erdogan, 2018; Nayci, 2017); while others were conducted in other courses and at different educational levels (Carlisle, 2018; Cakir, 2017; Duffy, 2016; Gross, 2014; Guggisberg 2015). Quantitative data were used to reveal how and in which activities the increase in academic performance was realized and e-learning videos out of the classroom were found to be effective in this regard. In support of this result, Herreid and Schiller (2013) emphasize the importance of videos that enable students to focus on content in flipped classroom practices and emphasize that such videos will positively affect the classroom process and bring about a student centered environment.

In addition, Hsin and Cigas (2013) showed that video usage increases students' achievement scores, in line with the results obtained in the research. One of the most important features of videos that increase academic performance is that they can be watched again in a quiet environment according to learning preferences and stay in the virtual classroom system at all times. In support of this result, Oyola (2016) concluded that flipped classroom practices encouraged the student to learn at home and that reteaching was facilitated by watching the videos again. In addition to this feature of the videos, the questions included in the videos also positively affected the increase in academic performance. Similar to this result, Wilson (2016), in his research, tried to reveal the effectiveness of the questions added to the videos he shared in the Edpuzzle application and as a result of the research, the questions added to the videos were found to be effective in improving students'

learning. It was however revealed in this research that the flipped classroom has brought about positive change in the attitude of students towards practical physics classes.

Conclusion

In general, it is seen that the results of this research, in which the effect of flipped classroom practices on students' academic performance in practical physics among secondary schools in Lagos State, is in line with the results of studies in the literature. From this point of view, it can be said that benefiting from flipped classroom practices course has a positive effect on students' academic performance and this would in turn bring about higher scores in physics at both school examination and external examination such as WASSCE and NECO SSCE. Not only would their scores be high it was also observed that a positive attitude towards learning of physics practical concept amongst physics students at the senior secondary level of SS I, SS II and SS III across secondary schools in Lagos State and Nigeria at large would be recorded.

Recommendations

From the findings of this research, the researchers came up with the following recommendations

- Policy makers and curriculum planners should add the usage of flipped learning to the already existing conventional mode of teaching (lecture method)
- Physics teachers across Nigeria and globally should be introduce the Flipped classroom model in their classrooms for teaching of concepts in physics and all science subjects.
- Student in science classes should be advised and encouraged by their teachers to watch the teaching of various concepts in physics and others science subjects on youtube outside class hours or at home.

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