Flipped Classroom; An Outstanding Pedagogical Innovation for Teaching – Learning Physics in Higher Education in Nigeria.

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ABSTRACT

This is a pilot study that investigated the effect of flipped classroom on Physics students in Higher education in Nigeria. It also employed the pre-test – post-test, control group, quasi-experimental design. A questionnaire for data collection was used, fifty-three (53) science student from different discipline participated in the study. An inferential statistics involving computing Analysis of Covariance (ANCOVA) to test all stated null hypotheses, while Scheffe post-hoc test was used to determine the source of observing significance on ANCOVA. Findings revealed that there was significant effect of the use of flipped classroom instructional model on students' achievement in physics, it also indicated that there was no significant main effect of gender on student's Academic achievement in Physics and further reveal that the two way interaction of treatment and gender was not significant on students' achievement in Physics. Also the study concluded at this point that flipped classroom instructional model is one of the effective instructional approaches' to teach concepts in Physics and other Sciences especially in higher education because students are responsible for their own learning, learning at their own pace and it increases collaborative learning. It has shown statistical significant as evidence that it's enhanced students' academic achievement. The strategy also is neutral to gender, thereby corroborating its relevance as an instructional strategy in study of physics which is not gender-bias but improves learning and engagement as it creates rooms for student's critical thinking, problem- solving or higher-order thinking. Finally, based on the findings in this study, it was recommended that the flipped classroom strategy should be inculcated into teacher-education curriculum as both in-service and pre-service physics teachers should be exposed to flipped classroom /learning as a mean instructional delivery and encouraged by curriculum developers.

KEYWORDS: Flipped classroom, Flipped learning, Pedagogy, Computer, Teacher Education and Technology Integration in higher Education.

1.0 Background to the Study

Flipped classroom which means students gaining first exposure to new material outside of class, usually via reading or watching lecture videos, virtual laboratories, simulations and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion and collaboration has become the latest buzzword in pedagogical approach to learning in higher education as reported by *The New York Times* (Fitzpatrick, 2012); The Chronicle of Higher Education (Berrett, 2012); and *Science* (Mazur, 2009). It is seen as an inverted classroom where students get their first hand information about the subject matter outside the classroom thereby encouraging student- centered approach to learning. Flipped classroom is a tacit admission that students no longer have the attention span to learn in old way (rigorous lecture method), which requires that they listen carefully to someone spinning a factual narrative, pay close attention, take detailed notes and take much of this information to memory. The use of flipped instructional model (such as video-recorded lectures) to compliment the traditional (face to face) teacher centered method of learning has given the learner (student) responsibility for his own learning.

Restad,(2013) observed that flipped learning is partially well suited for science education for variety of reasons, the in-class discussion and enrichment activities allowed by moving content delivery outside of the class time provide opportunities for students to develop vital skill still needed in 21st century, including critical thinking, creativity, communications, problem-solving

skills and collaboration. Physics being a branch of science concerned with nature and properties of matter, also is practically oriented which requires more time for understanding its concepts in detail. Because it is difficult to present physics to the understanding of student within the conventional period of teaching, thus the need to use Flipped classroom (videos, virtual laboratories, simulations outside the classroom) to compliment the traditional or conventional approach to teaching physics in classroom. Freedman (2015) speculated that every physics instructor has heard this complaint from students at one time or the other ‘’I understand the concepts but just can’t do the problems’’. In order to solve problems in Physics, students understanding of theories in Physics aren’t enough but require the use of fundamental concepts with equations and their derivations making students think like a Physicist.

Moreover, educators that have implemented the use of the flipped classroom have reported positive results in their classrooms and students are more engaged in their own learning by collaborative problem solving with the teacher and the other students (Electronic education report, (EER.) 2011). Heller, Keith, Anderson and Hollabaugh (1992) suggested that students taught with greater emphasis on general problem-solving strategy based on the methods used by ‘‘experts problem-solver’’ reflected attitude and attributes of a real scientist (Physicist) and engineers. To reinforce the use of the problem-solving strategy through flipped classroom which give room for the in-class time to be used for collaboration, co-operative group learning and greater interaction between teacher - student and student - student should be encouraged. At the heart of Physics education research there is a shift in emphasis on Physics instructions from what are we teaching and how can we deliver it?, to what are the students learning and how do we make sense of what they do ?. And in order to make this shift a reality, we need strategies such

as flipped classroom instructional strategies for teaching physics in our higher education. Edward, Redish and Richard, Steinberg (1999).

Herreld and Schiller (2013) revealed that despite the benefit of flipped classroom there is a price to be paid by the teachers which include greater preparation time, student resistance to novel teaching methods, and a concern on the part of many teachers about content coverage. The latter is especially worrisome to STEM (Science, Technology and Engineering and mathematics) instructors who equate coverage with learning. These challenges are sometimes subdued by the awareness of Teachers /instructors that the use of technologies make them progressive and pedagogically sound.

Interestingly, the idea of the "flipped classroom" wasn't new in 2012 nor was it something devised by Khan Academy or TED. Video-taped lectures assigned as homework can be traced back to Colorado math teacher Karl Fisch who had his work popularized in turn by a story in 2010 by Daniel Pink who called the practice "flip thinking" or the "Fisch flip." But well before that, many other educators were thinking about ways they could "flip" or reverse instruction: chemistry teachers Jonathan Bergmann and Aaron Sams recorded their lessons 2007. And in the 1990s, Harvard professor Eric Mazur pioneered the idea of peer instruction in order to alter his own teaching practices away from heavy reliance on lecturing.

In Nigeria, idea of using technology in teaching is not new and the technology integration in classroom have been affected by the shortage of qualified teachers who are associated with high quality instruction (Ajayi, 2005), lack of interest and commitment of Nigerian science teachers to their profession (Olarenwaju, 1999), gender factor (Ebere, 2006), parental educational background (Adeogun, 2009), poor understanding of the scientific concepts by the students

(Erinosho, 2004), deficiency in teachers' preparations (Ogunleye, 2008), and. inadequate provision of instructional resources that could facilitate science teaching and learning (Olagunju, 2000a). One notable of such factors is the teaching methods that do not enhance critical thinking and are not student-centered especially the conventional teaching method (Ajayi, 2005; Afuwape, 2004; Alake, 2007).

1.1 Statement of the Problem

Considering the fact that Physics involves a lot of problem solving exercises within a limited classroom period which is inadequate for the extensive coverage of the curriculum, it became expedient for classroom teaching to be enriched with new and innovative pedagogical skills in order to reinforce learning and maximize the allocated time towards greater students' achievement in Physics. The use of flipped classroom involves students watching the theoretical part of the lectures on videos in their homes; it has given rise to increase/active participation and collaboration among students in the normal class time due to the control they have over their learning via the videos. More so, there is need to engage the learners in activities that will encourage the acquisition of problem-solving skills and a scientific attitude which is not being achieved as a result of poor laboratory facilities and conventional teaching activities in physics courses. Flipped classroom seem to be a valuable medium through which educators can tap from the power of Video-tape lectures, virtual laboratories, simulations to help learners develop higher cognitive processes and problem solving skills while the learners interest is sustained and learning outcome improved. It is against this background that the study seeks to investigate the effect of flipped classroom instructional strategies on pre-degree students' achievement in Physics.

1.2 Hypothesis

Based on the stated problem, the following hypotheses were tested at 0.05 level of significance.

$H0_1$: There is no significant main effect of treatment on students' achievement in Physics

$H0_2$: There is no significant main effect of gender on students' achievement in Physics.

$H0_3$: There is no significant two-way interaction of treatment and gender on

Students' achievement in Physics,

1.3 Scope of the Study

The study is designed to examine the effects of flipped classroom-based instructional strategy and conventional strategy on students' learning outcomes (achievements) in Physics at Babcock University pre-degree programme. The main and interaction effect of gender on the learning outcomes of participants in Physics would be determined. The study covered fifty-three (53) pre-degree Physics students from various courses/discipline in Babcock University, Ilisan–Remo, Ogun State of Nigeria. This study comprises of two (2) groups of students, of which one treatment is administered to using flipped classroom model and the other conventional model is used. Also, the study considered Concepts in Physics perceived to be abstract and difficult to learn, which form the basis for their selection from the Physics course content/curriculum.

1.4 Significance of the Study

The findings of the research work would serve as empirical evidence on the effectiveness of using Flipped classroom in Physics instruction in Nigeria among Physics/science teachers. It would also provide the basic guideline to Physics teachers in general on how to employ flipped

classroom-based instructions in teaching Vectors, Mechanics, Optics, Heat, Thermodynamics, Modern Physics and other related science concepts. It would serve as reference points and sources of information to curriculum and instructional designers, teachers and researchers who may be interested in the effectiveness of using flipped classroom in Physics and science instruction generally. The findings of this study would provide information that would assist the students to develop better attitude to Physics.

1.5 Definition of Terms

The following terms are defined for the purpose of this research work

Learning outcomes: These are the cognitive, affective and psycho-motor learning outcomes of students, measured by Students Achievement Test in Physics, Students Attitude Scale Questionnaire and Physics Problem- Solving Ability Test respectively.

Problem-solving ability: It is a unique intellectual process of thinking behaviour that is involved in finding solution to problem in Physics. It was measured using Physics Problem-Solving Ability Test.

Homework: This is the activities given to the student by their teacher to be done at home and submitted in the subsequent class for marking.

Flipped classroom: This is an instructional approach which involves Video-taped lecture given to students to view ahead of the lesson while further discussion, participation and collaboration is done in the proper class time based on the subject matter.

Flipped learning: This is a form of student-centred learning concept where learners are exposed to content outside the classroom and come to do activities in class.

Video–taped lecture: This audio-visual learning material (animations, simulation and Videotext) produced prior to the lesson period to expatiate on the nitty-gritty of the subject matter in a more explicit and practical form.

Theoretical Framework:

Constructivism Theory (Piaget 1967 and Vygotsky 1978).

Jean Piaget and Lev Vygotsky are two eminent figures in the development of constructivist theories and shared the common belief that classrooms must be constructivist environments; however, there are differences in terms of their theories and variations as to how constructivism should be carried out in classrooms. Constructivism is a new approach in education that claims learners/students are better able to understand the information they have constructed by themselves. According to constructivist theories, learning is a social advancement that involves language, real world situations, and interaction and collaboration among learners. The learners are considered to be central in the learning process. Constructivism transforms today's classrooms into a knowledge-construction site where information is absorbed and knowledge is built by the learner.

In constructivist classrooms, unlike the conventional lecturer, the teacher is a facilitator and a guide, who plans, organizes, guides, and provides directions to the learner, who is accountable for his own learning. The teacher supports the learner by means of suggestions that arise out of ordinary activities, by challenges that inspire creativity, and with projects that allow for independent thinking and new ways of learning information.. Constructivist theories have found

more popularity with the advent of personal computers in classrooms and homes. PCs provide individual students with tools like watching video lectures to build their own learning at their own pace. The basis of the theories used for justifying the flipped classroom typically points at reasons for not using classroom time to deliver lectures. These arise from a large body of literature on student-centered learning, which focus basically to the theories of Piaget 1967 and Vygotsky 1978. Piaget further said that the mechanism of learning is the process of equilibration in which cognitive structure assimilates and accommodate to generate new possibilities when it is disturbed based on human self-organizing tendency. The theory of conceptualization is relevant after watching lecture Video at home, bringing to the theoretical aspect to bear in proper class time activities which includes classroom collaboration, engagement and problem solving that optimizes the class time resulting to generation of further knowledge through interaction with student to student or teacher to student. The end result of all the activities involved in both the theories and flipped classroom process is that learning occurs as result of given the learner (student) responsibility for his own learning.

Review of Literature

i. Concept of Flipped Classroom

The "flipped classroom" one of the latest buzzwords in education, but is not totally a new concept or innovation. Teachers often give students readings and other study materials to use at home, and then expect the students to engage in conversations and interactions about the reading in class. This technique could be classified as an inverted classroom (Strayer, 2012). However, a few key characteristics distinguish the flipped classroom from an inverted classroom. In the flipped classroom, students are made to watch video-recorded lectures outside of class, thus

increasing time for active learning and proper class interaction (Strayer, 2012). The implementation of this method may be slightly different amongst teachers, but essentially "the 'flipped' aspect of the flipped classroom ensures that students watch or listen to lessons at home and do their 'homework' in class" (Fulton, 2012).

Online learning has various aspects. Historically, video lectures were originally created to make curriculum accessible to all students especially to those who live far away from the school or those who couldn't make it to the lecture hall. Teachers began to realize that videos did not only help off-site students, but also students who were present during lectures (Cascaval, Fogler, Abrams, & Durham, 2008). Online classes gained popularity in the past decade, especially at the college level. However, students commonly complained about limited and indirect interaction and communication in purely online classes (Gecer & Dag, 2012). Flipping the classroom involves online learning and studying through a series of video lectures, but this enhanced method of learning is supported by face-to-face classroom discussions, interactions and individual help. Thus, the flipped classroom is clearly different from the traditional online learning environment.

Traditional classroom lectures often follow a one-pace-fits-all philosophy. Teachers try to adjust their lectures based on the feedback they get from students, because some students assimilate the lectures at a fast rate while others assimilate slowly. Video lectures provided through the flipped classroom model allow students to be able to fast forward through examples they already understand, or pause and rewind to revisit topics which may require more processing and assimilating time (Goodwin & Miller, 2013). Videos allow lectures to be broken into pieces, as opposed to traditional instruction which often contains a large volume of content delivered at once (Brecht & Ogilby, 2008).

Salman Khan, a widely recognized online educator, popularized the flipped classroom through his website, Khan Academy. This website contains over 4,120 short educational videos, including specific detailed math concepts (Thomas, 2013). Khan works problems step by step on each video. “Khan’s idea was that youngsters would be able to watch the videos at home and work on problems in class, essentially ‘flipping’ the classroom” (Kronholz, 2012). Students also explore the website frequently to get homework help when they are stuck on a problem. Khan seeks to change the way people think about education, emphasizing “the old classroom model simply doesn’t fit our changing needs” (Khan, 2012).

Many schools and educational institutions have used Khan’s videos to flip the classroom. Greg Green, the principal of Clintondale Community Schools in Michigan commended the flipped classroom for its ability to assist students who do not get adequate homework help at home (Finkel, 2012). Students now receive guidance at home in the form of video lectures, and can directly interact with teachers and peers during class time to get answers to their questions. Teachers utilizing Khan Academy to flip their classrooms realized they often work harder during the school day as they are always moving around and interacting with students. It must be noted Khan Academy is not meant as a fix-all. Math teacher Courtney Cadwell commented, “Khan is not great at helping kids conceptualize math” (Kronholz, 2012). Video lectures needs to be supplemented with activities which encourage discussion and emphasize the practical and applied side of mathematics. When flipping the classroom, teachers must constantly interact with students, adjust instruction on the fly, make the class lively and active, and design activities which complement the videos in order to create a wonderful scenario for effective learning

ii. Flipped Classroom and Academic Achievement

Many studies on flipped classroom and its effects on students' achievement are emerging in various popular publications. Most of which reflects the effectiveness of flipped approach towards improving students' academic achievement both in attitudes, problem solving skills, and perception etc. Rasmussen (2013) investigated the effects of the flipped classroom on academic performance of high school advanced placement chemistry students. Student perceptions about the approach were also studied. The control group consisted of students from the 2011-12 academic years, in which traditional teaching methods were used. The treatment group consisted of students from the 2012-13 academic years, in which the flipped classroom approach was used. Identical assessments were administered and analyzed through both descriptive statistics and independent t-tests. A statistically significant difference was found on all assessments with the flipped class students performing higher on average. In addition, most students had a favorable perception about the flipped classroom noting the ability to pause, rewind, and review lectures, as well as increased individualized learning, and increased teacher availability. Stacey-Roshan (2011); revealed that using flipped class leads to an increase in students' performance and emphasized that flipping the class room was not about creating more work for the students, but changing the type of work that students do at home and changing the class experience.

Akingbemisilu (2014) in his study on the effect of flipped classroom strategy on Adekunle Ajasin University students' Achievement in Some Concepts of Biology revealed that though flipped classroom strategy has slightly improvement students mean score in Biology at undergraduate level, it has not caused significant effect in the performance due to some factors. However, Flaherty and Philips (2015) indicated that there is much indirect evidence emerging of improved academic performance and student and staff satisfaction with the flipped approach but

a paucity of conclusive evidence that it contributes to building lifelong learning and other 21st Century skills in under-graduate education and post-graduate education.

iii. Criticisms about the Flipped Classroom

The Flipped Classroom, even with all its novel educational ideas has its critics. Since the Flipped Classroom concept is still in its infant stage, there are insufficient numbers of articles reporting on its instructional impact. However, there are numerous online blogs and non-refereed write-ups that criticize many aspects of its Instructional use. Wheeler (2012) has placed concern on the Flipped Classroom in his educational blog. Wheeler began by saying that “what 'flipping the classroom' boils down to seems, it is the creation of online content including videos that tarnishes the need for students to physically attend lectures". Wheeler’s second concern with the Flipped Classroom is the enormous division between those who can and cannot afford the necessary equipment and technology. The basic ideology of the Flipped Classroom assumes that students will watch a lesson video outside of the educational four walls which means they need technology to view the video and a constant internet connection. Wheeler goes further on to point out that he feels that instead of replacing lectures with videos, efforts should be spent on improving lecturing. Wheeler believes that by removing traditional lecture method, we are not providing students with quality education and students will demand better quality for their tuition fees.

Finally, Wheeler says “asking them [students] to stay at home, watch a video and then do an assignment based on their own independent study isn’t going to help matters”. Pettigrew (2012) refers to the Flipped Classroom as a popular phenomenon in education. "Flipped learning has just enough sense in it to make it appealing and to give its advocates a feeling of superiority that

sometimes make people have the feeling of being right. But like most Phenomena, it pushes reality aside". Pettigrew believes it is possible to have impactful innovation in education but most of the time individuals are already doing it or there are reasons why they are not. Pettigrew also notes that humanities professors have been flipping their classroom for a number of years; students are exposed to materials/videos before the normal class time of which activities involving engagements, collaboration and problem solving or high order thinking occur under the guidance of the teacher within the normal class time. Pettigrew agrees with the view considering that bad instructors need to be removed and new ones should be brought into the system, although he feels there are many professors whose lectures can be participatory and do more than just knowledge dissemination. "Good lecturing provides information and knowledge. Outstanding lecturing allows for asking questions and giving adequate answers to things that are best done live and in person and the very things that flipped learning advocates are looking for".

iv. Empirical Review

There is relatively minimal amount of literature on the effectiveness of flipped classroom; Sophia and flipped learning network (2014) reported improvement in student's engagement. There are challenges to its implementation for students to acquire foundational knowledge in flipped learning. In flipped learning, students must recognize and demonstrate self-directed learning skills to be successful. The flipped classroom teachers must be able to respond to spontaneous questions from students after pre-class activities (Berrett 2012, Wang, & Zhag 2012). The aim for effective in structural design is to establish conditions for learning with particular attention to activities that generate awareness, near transfer, and far transfer of course content.(Clark & Mayer 2011;Gagne 1985: Horton 2012). This paper examined the concept of

the flipped class room from this perspective. The authors have provided a review of the literature and related research, and have presented practical strategies for effective implementation.

The literature reviews reinforces the sense that the flipped technique is useful when seeking to optimize class tune, support the development of higher-order thinking skills and enhance teacher-student and student peer to peer interactions. The success of a flipped approach hinges on the synergy between instructor and students and requires sustained motivation and contribution before, during and after live instruction. When used appropriately, flipping the contribution before, during and after the classroom is a valuable addition to higher education practice as evidenced in the research. Also the use of instructional video-taped lecture have revealed a progressive influence on student attitudes (Bolliger, Supanakorn, & Boggs, 2010; Fernandez, Simo, & Sallan, 2009; Hill & Nelson, 2011; Holbrook & Dupont, 2010; Lonn & Teasley, 2009); student behavior (Chester, Buntine, Hammond, & Atkinson, 2011; Foertsch, Moses, Strikwerda, & Litzkow, 2002; McCombs & Liu, 2007); and student performance (Alpay & Gulati, 2010; Crippen & Earl, 2004; Traphagan, Kusera, & Kishi, 2010; Vajoczki, Watt, Marquis, & Holshausen, 2010). All of these speak volume for their use in the flipped classroom Studies which revealed positive impact on students' learning outcomes.

Today's students have different educational preferences as generations pass by, and teachers must observe this paradigm shift and act towards it in order to give their students the possible best .Access to technology is now more prevalent than ever before, and the flipped classroom taps and extends into these resources. Assigning video lectures as homework can free-up class time, which in turn provides increased opportunities for teacher to obtain a feedback from their students and also creates a scenario for student collaboration. The flipped classroom model makes the video-recorded lecture a medium for meaningful educational outreach, lessons are

broken into simpler bits; the lecture videos can be accessed at any time; and more chances are created for interaction, collaboration, even problem solving amongst students. This feature meets up to the learning preferences of the New Generation described by Skiba and Barton (2006). Research has shown that flipped classroom is not a new innovation, and its growth relies on its implementation. No single method has proven to be more effective, but the flipped classroom has reflected light on a path to approach the dynamic demands of students in this era of technology advancement.

1.7 METHODOLOGY

1.7.1 Research Design:

The study employed the pre-test – post-test, control group, quasi- experimental design. The design is symbolically represented as

O_1 $X1$ O_2 Experimental Group

O_3 $X2$ O_4 Control Group

Where O_1, and O_3 represent the pre-test for the experimental group and the control groups respectively. O_2, and O_4 represent the post-test for the experimental group and the control groups respectively.

X1 ------- Treatment group (Flipped Instruction)

X2 ------- Conventional lecture instructional strategy

The study used 2x2x2 factorial matrix presented in Table 1.1

Treatment	Gender	Achievement	
		Low	High
Flipped Instruction	Male		
	Female		
Conventional Lecture instructional strategy.	Male		
	Female		

1.7.2 Variables in the Study

The variables in this study are:

Independent Variable – instructional strategy at 2 levels

(i) Flipped Classroom

(ii) Conventional Lecture instructional strategy

Moderating Variables;

Gender at two levels (Male and Female)

Dependent Variables;

Students' Academic Achievement in Physics

1.7.3 Selection of Participants

The target population of this study comprised all Pre-degree students offering General Physics 011 in Babcock pre-degree programme for 2013/2014 session. The students were further

randomly assigned to treatment groups and control group. One intact group of students then randomly selected from each group. Fifty three (53) Pre-degree students were used in the study, two research assistants and one teacher.

1.7.4 Research Instruments

Three instruments were developed and used in this study. These are:

(i) Students' Achievement Test in Physics (SATP)

(ii) Flipped classroom Instructional Guide (FCIG)

(iii) Conventional Lecture Instructional Guide (CLIG)

1.7.5 Students' Achievement Test in Physics (SATP)

This was a multiple choice test developed by the researcher to measure the level of students' knowledge of selected concepts in Physics based on the first three levels of cognition thus, Remembering, Understanding and Thinking (Okpala 1985). It comprised of sections A and B. Section A was on demographic information, while section B comprised of twenty five (25) multiple choice items. Each item has one correct answer and four distracters. The items were drawn from the concepts of ''Quantum Mechanics'' with concentration on Photoelectric effect in Physics. A table of specification was used for the test on (i) history of photoelectric effects (ii) significance for practical application (iii) calculation on effect of visible light (iv) nature of its Wavelength and calculation (v) fundamental principle of Quantum mechanics (vi) calculation on energy of emitted electron (vii) calculation frequency of electron (viii) optical intensity (ix) Discrete nature of light (x) calculation on the existence of quanta (xi) calculation on secondary emission (xii) Calculation on kinetic energy of the emitted electrons.

1.7.6 Validation of SATP

The validation of the instrument was done by experts review and the reliability co-efficient computed using KR-20 formula. The reliability value was 0.7536 and average item difficulty value was obtained to be the guessing level is (1.00/2 = .50) and, therefore, the optimal difficulty level is .50+(1.00-.50)/2 = .75. This shows that the test items to be used are not too simple or too difficult.

1.7.1.0 Research Procedure

The following stages were involved in carrying out this study.

The first week was used for conducting pretest using all these instruments in the SATP,

The second week was used for the main treatment using flipped classroom instructional strategies for experimental I and II respectively and conventional lecture strategy for the control.

The third week was used for the conduct of post-test evaluation for all the groups.

1.7.1.1 Conventional Lecture Strategy (control group)

No flipped teaching would be used to teach this group, rather they were taught the same concepts conventionally and the learners were not divided into groups. They were taught the same concepts as in the experimental group.

1.7.1.2 Administration of Pretest

All the participants in both the experimental and control groups were pre-tested using the instruments, SATP. This lasted for one week.

1.7.1.3 Administration of the Post Test

The treatment period last for one week lesson period after which the post test was administered by the researcher on the three groups using the same instruments, SATP as for the pretest.

1.7.1.4 Methods of Data Analysis

Data collected was analyzed using the inferential statistics involving computing Analysis of Covariance (ANCOVA) to test all stated null hypotheses, while Scheffe post-hoc test was used to determine the source of observing significance on ANCOVA.

1.8 Results

1.8.1 Testing of hypotheses

$H0_1$: There is no significant main effect of treatment on pupils' achievement in Physics.

Table 1.3 Tests of Between-Subject Effects

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	372.959[a]	12	31.080	10.456	.000	.754
Intercept	111.911	1	111.911	37.648	.000	.479
Pretest	17.304	1	17.304	5.821	.020	.124
Treatment	193.435	1	193.435	65.074	.000	.613
Gender	.502	1	.502	.169	.683	.004
treatment * gender	4.226	1	4.226	1.422	.240	.034
Error	121.875	41	2.973			
Total	7095.000	54				
Corrected Total	494.833	53				

Table 1.3 indicates that the main effect was significant on pupils' achievement in Physics ($F_{2, 100}$= 65.07; $p < 0.05$; partial eta squared = 0.613), which gives an effect size of 61.3 percent. Thus, $H0_1$ (i) was rejected.

H0 $_2$ **:** There is no significant main effect of gender on pupils' achievement in Physics.

Table 1.3 shows that the main effect of gender was not significant on pupils' achievement in Physics ($F_{2,\ 100}$=.169p>0.05; partial eta squared = 0.004), which gives an effect size of 0.4 percent. Hence, the null hypothesis ($H0_2$ (i) was accepted

$H0_3$ There is no significant two way interaction of effect of treatment and gender on achievement in Physics

Table 1.3 shows that the two way interaction of treatment and gender was not significant on pupils' achievement in Physics ($F_{2,\ 100}$=1.422p>0.05 partial eta squared = 0.034), which gives an effect size of 3.4 percent. Hence, the null hypothesis ($H0_3$ (i) was accepted

1.9 Discussion, Conclusion and Recommendation

This study revealed that there was a significant effect of the use flipped instruction model on student achievement in Physic, which means that flipped instruction model is one of the effective instruction strategies to teach concepts in physics. Because the use of Video recoded lecture, simulations, the in-class discussion and all other enrichment activities allowed by moving content delivery outside of class time provides opportunities for students to develop vital learning skills needed in the 21st century including critical thinking, creativity, communications, and collaboration. This is in support of the conclusion drawn from Flaherty and Philips (2015) indicating that there is much indirect evidence emerging of improved academic performance and student and staff satisfaction with the flipped approach but a paucity of conclusive evidence that it contributes to building lifelong learning and other 21st Century skills in under-graduate education and post-graduate education. And from experiment by instructors including 2011 Nobel Laureate Carl Wieman that using these active learning methods such as flipped classroom

can improve both learning and engagement. (Neil Aronson in Pearson 2013). They further ascertained that it improved students' critical thinking, creative problem solving or higher-order thinking, and 21st century professional skills, increase student participation, engagement, and motivation, improve students' team-based skills and peer-to-peer interaction, customize or differentiate learning, make students the center of learning or encourage student ownership of learning, better faculty to student interaction, increase faculty freedom/enjoyment, improve learning outcomes, dealing with absences, encourage faculty collaboration, and compensate for limited classroom space.

Restad, (2013) stated that *"*In the end, the benefits of the flipped approach are considerable. Students take more responsibility for their own learning. Working in class along with a master of the discipline makes students learn to think more critically, communicate more effectively, and have a greater appreciation for the unique importance and logic of the subject. And they experience at least some of the satisfaction of learning how to think in a new and, in some cases, life changing way. Moreover, the idea to effectively leverage emerging technologies like flipped learning/classroom will not only drive increased student achievement but also teachers' productivity thereby making them progressive and pedagogically sound.

Also the study indicated that there was no significant main effect of gender on students' academic achievements in Physics. This finding is synonymous with current literature on the issue. Literature shows no gender differences in the use of technology regarding learning outcomes, attitudes and perception (Bain & Rice, 2006; Hargittai & Shaver, 2006; Scherer, Sax, VanBiervliet, Cushman, & Scherer, 2005). It can be deduced that the performance level of students both male and female was the same, showing that they have equal opportunity to do better in any subject given the favourable condition.

Finally, the study reveals that the two way interaction of treatment and gender was not significant on students' achievement in Physics. This implied that the learner (whether male or female) does not significantly affect the performance of the learner in physics when flipped learning process is carried out. They may be attributed to the fact that the in-class time activities give room for equal opportunities for engagement, problem solving and collaboration between male and female student within the period of the class. From this findings, the treatment- gender gap is inadequate in comparison, meaning that educational differences between males and females appear to be diminishing, so it is likely that the technology gender gap will reduced as well, which is contrary to Heafner (2014) whose consideration of how technology is associated with gender-sensitive pedagogical thinking and practice may help unravel the aforementioned gap in technology usage and the result of his data analysis suggest that gender plays a critical role in technology integration. However, the insignificance in technology-gender gap may have risen due to higher percentage of female participation in the study thereby creating room for marginal reduction in the technology-gender gap.

Results of this research will have implications for curriculum innovator, instructional technology administrators, designers, and faculty members implementing a full or partial flipped classroom model.

1.9.1 Conclusion

The focus of this study was to ascertain whether the flipped classroom instructional model has any effect on students' academic achievement in physics and the results revealed that the academic achievement of the students exposed to the flipped classroom was enhanced. The result can be attributed to the fact that the students took responsibility for their own learning, were able

to replay parts of the lecture, participate in the in-class activities or small group discussion and collaboration which resulted in solving more problems in physics. This also implies that students' performance in Physics could be optimally improved through the use of flipped classroom. The strategy also is neutral to gender thereby corroborating its relevance as an instructional strategy in study of physics.

1.9.2 Recommendations.

Based on the findings, the following recommendations are proffered:

The flipped classroom strategy should be inculcated into teacher-education curriculum and encouraged by curriculum developers

Necessary facilities that can facilitate the effective use of flipped learning should be provided in all schools and homes.

Both in-service and pre-service physics teachers should be exposed to flipped classroom /learning as a mean instructional delivery.

Appropriate avenues should be created for Physics teachers in all educational sectors and even educational technologist to discuss and work on learning platform that can be used to all other topic in Physics.

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