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EFFECT OF BLENDED LEARNING ON STUDENTS' ACADEMIC PERFORMANCE IN PHYSICS IN FEDERAL COLLEGES OF EDUCATION IN SOUTH EAST, NIGERIA

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ABSTRACT: *This study investigated the effect of blended learning on the academic performance of Physics students in Federal Colleges of Education in South East, Nigeria. Two research objectives, two research questions as well as two research hypotheses guided the study. The population of the study comprised all the 287 Physics students in the three Federal Colleges of Education in South East, Nigeria. A sample of 81 students were purposively selected for the study from two of the three colleges. The instrument for data collection was a -50 multiple choice researcher-made test entitled Researcher Made Electromagnetic Theory Achievement Test (RMETAT). Test retest method was used to ensure the reliability of the instrument. Reliability coefficients of temporal stability of 0.97 and that of internal consistency of 0.72 were determined for the instrument. Mean, standard deviation and ANCOVA were the statistical tools used for data analysis. The study found out that blended learning increased the performance of Physics students who participated in the study. It was also found out that the performances of students were not dependent on their gender. The researcher, therefore among other things recommended that blended learning should be made a compulsory teaching strategy for Colleges of Education and similar institutions and that compulsory periodic training and retraining of teachers in institutions of higher learning on 21st century teaching strategies such as blended learning be put in place.*

KEYWORDS: blended learning, academic performance, physics

INTRODUCTION

The society today is technology-driven. Men and women alike have adopted technology into their daily affairs. Technology has permeated the society to the extent that in virtually every field of endeavour, there is one form of role or the other which technology can play and thus technology has brought in so many innovations in all fields of life. Take the banking sector for instance, one does not need to go to the bank to send money to friends and relatives. Just in the comfort of the home, with the mobile phone, relatives, friends and business associates are sure to get money. The ATM machine is available around the corner for one to withdraw and deposit money even when the machine is not owned by the bank he or she banks with. This is amazing. The educational system is not left out as technology has also made impact in it. (Nwobi, 2014) has it that the wind of globalisation and technological changes blowing over the past few decades now has created a

new global economy. For the author, the emergence of this new economy has serious implications on the nature and purpose of education. Technology is the practical application of scientific knowledge. It is the employment of man's resourcefulness and creativity for the improvement of his overall well-being. Vikoo(2017:1) defined technology as the making, modification, usage and knowledge of tools, machines, techniques, crafts, systems, and methods of organization, in order to solve a problem, improve a pre-existing solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function.

Technology has so many branches and educational technology is one of them. According to the Association for Educational Communications and Technology (AECT) as cited in Reiser(2012:4), "educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources." The process of creating and using of these resources no doubt has a very high potential of improving performance in education and other relevant areas for sustainable national development. Before now, the resources that were created, used and managed by educational technologists were mostly various hardware materials such as projectors, charts and models. But today, we are in the world of Information and Communication Technology (ICT). ICT refers to all the technology used to handle telecommunications, broadcast media, intelligent building management systems, audio visual processing, transmission systems, network-based control and monitoring functions (Techopedia, 2015). It has made many dynamic changes in society with influences felt more and more in schools, giving both students and teachers more opportunities in adapting learning and teaching to individual needs; challenging schools to aptly respond to this technical innovation. These types of technology according to Pacansky-Brook (2013) are called 'emerging technologies.' The author posited that emerging technologies are tools or types of tools that are making an impact in teaching and learning but are not yet adopted in mainstream teaching practice. These tools are "reinvisioning college learning" according to the author and fall into four categories which include: cloud based applications that are easily stored online and are accessible anywhere with internet connections; web 2.0 tools that make the creation and sharing of multimedia content simple; social media technologies that transform communication into a highly interactive experience and; mobile applications that are designed to operate on mobile devices such as smartphones and tablets.

Therefore, in this digital age, the first step in meeting student's needs is to adapt several curriculum delivery methods into the educational environment. Traditional large-group lectures may satisfy the learning styles of some students, while others may need more diverse methods. Today's digital natives make use of emerging technologies such as facebook, whatsapp, youtube etc on daily basis for purposes such as socialising and friendship. Therefore, a teaching strategy/approach incorporating a blend of these technologies into teaching and learning is likely to be a great asset towards improved performance, interest and retention for such ones. Such is blended learning.

Horn and Staker (2015:34) defined blended learning as "…any formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace." According to the author, it employs an appropriate balance

between—and implementation of— technology and face-to-face teacher/ student interaction to maximize a student's learning experience. This teaching approach/strategy occasioned by the advent of technology when adopted could have a positive impact in the teaching and learning of Physics.

Observation has shown that many students run away from this course both at the ordinary and tertiary levels. (Isola) 2010 put it that physics as one of the science subjects remains one of the most difficult subjects in the school curriculum according to the Nigeria Educational Research and Development Council (NERDC). It is also apparent that the rate of enrolment in Physics tend to be the lowest compared to other sciences (Mekonnen, 2014). Academic performance refers to the degree of a student's accomplishment of his or her tasks and studies. (Duruji, Azuh & Oviasogie, 2014). According to the authors the most well-known indicator of measuring academic performance is grades which reflect the student's "score" for their subjects and overall tenure. Success is measured by academic performance in most educational institutions. In this case, how well a student meets standards set out by an institution itself or an external examination body either set up by the government or an independent outfit signifies success or good performance.

For Bala(2014), academic performance is the outcome of educational goals that are achieved either by students or the teacher, i.e., how well a student meets standards set out by local authority or the institution itself . Academic performance refers to how students deal with their studies and how they cope with or accomplish different tasks given to them by their teachers. It is the ability to study and remember facts and being able to communicate your knowledge verbally or down on paper. Thus, it implies a process where a student's success in school is measured to determine how they stand up to others in the same areas.

The Cambridge University Reporter as cited in Jayanthi, Balakrishnan, Ching, Latiff & Nasirudeen(2014:752)) posited that academic performance "is frequently defined in terms of examination performance." For the authors academic performance is characterised by the overall performance in each year which culminates in a Grade Point Average (GPA). The GPA score usually takes into account students' performance in tests, course work and examinations.Talking about performances in Physics by those who offer it, the case is not different. Kola (2014) identified three major problems of Physics education in Nigeria and in Africa at large among many others as low students' enrolment, poor students' performance and lack of qualified teachers to teach Physics. The author added that Physics has been seen as a course where students' performances have not been encouraging. Erinosho's as cited in Kola (2014) had it that evidence abounds that there are massive failure in public examinations like West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO) in Physics in Nigeria. The author explains further that slightly over 30% of students who registered for Physics passed at credit level as against 40% in Biology and Chemistry. The poor performance is not only limited to secondary schools as observed by Stephen (2010) that there is poor performance of students in Physics both at secondary and post- secondary levels in Nigeria, Colleges of Education inclusive. This has been a source of concern for everyone. For example this review of the performance scores of Physics students of Alvan Ikoku Federal College of Education Owerri in

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the electromagnetic theory course (PHY 451) for a -5 - year period as shown below can attest to it.

Table 1: Trend of Performance of Students in PHY 451 for five sessions (2012/2013-2016/207)

Session	% of students Scoring Grades					
	A	B	C	D	E	F
2012/2013	4(7.0)	9(15.8)	11(19.3)	5(8.8)	13(22.8)	15(26.3)
2013/2014	6(13.6)	10(20.5)	11(25)	6(13.6)	8(18.2)	5(11.4)
2014/2015	6(14.6)	13(31.7)	5(12.2)	7(17.1)	8(19.5)	2(4.9)
2015/2016	4(10.5)	7(18.4)	12(31.6)	4(10.5)	-	6(15.7)
2016/2017	6(12)	2(3.5)	12(24.0)	8(16.0)	-	22(44.0)
Source: Dept of Physics, Alvan Ikoku Fed. College Of Education, Owerri.						

This no doubt that this can be traceable to the teaching strategies used by the physics teachers and lecturers (Nicholas, 2012, Mekonnen, 2014). For a better result to be achieved, state of the art approaches, methodologies and teaching strategies need to be employed especially those involving elements of the computer as authors, Serteller and Ustundag (2018) have identified. This is what blended learning is all about.

METHODOLOGY

The study adopted the non-equivalent control group quasi experimental design otherwise known as the pre-test, post-test, control group design and involved one level of experimental (flipped classroom model of blended learning,) and one control group (traditional teaching method), which the student-teacher discussion strategy was emphasized. The unit course, Phy 451, electromagnetic theory was the course taught. Performance was the dependent variable while gender served as the moderating variable. The population of the study consisted of all the Physics students in the three Colleges of Education in the study. They are 287 in number (168 males and 119 females).

Table 2: Population Distribution of 1st Degree Physics Students in Federal Colleges of Education in South East, Nigeria.

School	A	B	C	Total
No of Males	78	68	22	119
No of Females	68	37	14	168
Total	146	105	36	287

(Source, Physics Dept. of the Schools)

The researcher purposively selected two of the three school, i.e. Alvan Ikoku Federal College of Education, Owerri and Federal College of Education Technical Umunze for the study considering the fact that Federal College of Education Ehamufu is located at a distance very far to access by the researcher.Final year Physics students of the two institutions were purposively sampled in intact class. This is because many of them who offer electromagnetic theory (Phy 451) at this level fail and come back to rewrite the course, thereby spending extra year before graduating. They are 81 in number.

Table 3: Sample Distribution of Final year Physics Students in Federal Colleges of Education in South East, Nigeria.

School	A	B	Total
No of Males	29	12	41
No of females	31	09	40
Total	60	21	81

(Source, Physics Dept. of the Schools)

The instrument for data collection was a fifty multiple choice question entitled "Researcher-Made Electromagnetic Theory Achievement Test"(RMETAT). Researcher made electromagnetic theory achievement test (RMETAT) questions consisted of a test of the cognitive learning outcomes in physics(Electromagnetic theory) based on the course content of the unit course(Phy 451 Electromagnetic theory) as studied at the final year level in Colleges of Education and were fifty in number. The fifty multiple choice researcher made electromagnetic theory achievement test was developed from the course content, lesson notes and past question papers from the Physics Department of the various institutions as well as materials from the internet. The instrument was given to two experts from the Department of Physics and one from Measurement and Evaluation. The researcher added and removed certain items to the instrument based on the inputs made by the experts.

A pilot test was carried out for the instrument,(Researcher Made Electromagnetic Theory Achievement Test(RMETAT) and the test retest method was used to determine the reliability of the instrument. Pearson product moment correlation was used to determine the reliability coefficient of temporal stability of RMETAT as 0.97 and the Kuder-Richardson Twenty (K-20) formula used to determine the reliability coefficient of internal consistency of 0.72 for the instrument. The study lasted for Sven (7) weeks. The first week was used to familiarise with the subjects as well as the research assistants, the actual study lasted for six (6) weeks. A pretest was given at the beginning of each topic and a posttest at the end of it. The experimental procedure was organised into the following namely: the pre-treatment, treatment and post-treatment phases:

Pre-treatment phase:
The researcher visited the schools and the departments where the study was carried out and familiarised himself with the participants as well as train research assistant to assist him during the experiment. These were lecturers in the department who were familiar with the students and have been teaching them. Their role included to help him administer both the pre-test and posttest, as well as to make sure that the procedures for the study were not hindered in any way. Treatment Phase:

The researcher gave the treatment i.e. exposing the experimental group to lessons using the blended learning (flipped classroom) strategy through the help of the trained assistants. The treatment consisted of six lessons taught the students using the flipped classroom model of the blended learning. The lessons were on six topics in electromagnetic theory which consisted of the following in the sequence in which they were taught for the six weeks:

i. Maxwell's equation in differential form
ii. Maxwell's equation in integral form
iii. Poyting vector
iv. Waveguides
v. Transmission lines
vi. Antenna arrays

These were taught using the lesson plans prepared for this purpose. Each lesson lasted for one week. For each of the lessons, the students were sent youtube video links that contain videos on the lesson to be presented to a class group whatsapp page created for the purpose of the research. Those that did not have smartphone were given CDs containing the videos to watch at home. This served as the flipped classroom. During the face-to- face classroom, they also had the opportunity of watching the videos again but now in groups each of which had a leader who had to present a summary of their discussions on the videos to the entire class afterwards. The teacher as a facilitator supervised the activities and gave a summary at the end of each class.
Post-treatment stage:

Data were collected from the tests (pretest and posttest) administered during the course of the treatment. Mean and standard deviation were used to answer the research questions while the analysis of covariance (ANCOVA) was used to test the hypotheses at an alpha level of 0.05.

Purpose of the study
The main purpose of this study was to investigate the effect of blended learning (flipped classroom) on the academic performance of Physics students in Federal Colleges of Education in the South East, Nigeria.

Specifically, the study set out to:
1.find out whether there is any difference between the mean performance scores of students taught Physics with blended learning(flipped classroom) and that of those taught with discussion strategy at posttest;
2. determine whether there is any difference between the mean performance scores of male and female Physics students taught with flipped classroom at posttest;

Research Questions
1. What is the difference between the mean performance scores of Physics students taught with flip classroom and that of those taught with discussion strategy at posttest?
2. What is the difference between the mean performance scores of male and female Physics students taught with flipped classroom at posttest?

Hypotheses
1. There is no significant difference between the mean performance scores of Physics students taught with flipped classroom and that of those taught with the discussion strategy at posttest;
2. There is no significant difference between the mean performance scores of male and female Physics students taught with flipped classroom at posttest;

Results:
Research Question 1: What is the difference between the mean performance scores of Physics students taught with flipped classroom and that of those taught with discussion strategy at posttest?
Table 4: Analysis of mean scores of the performance of physics students taught with flipped classroom strategy and that of those taught with the discussion strategy at posttest?

Strategy	Pretest		Posttest		Mean Difference
	$\bar{x}$	SD	$\bar{x}$	SD	
Expt. Group	12.37	6.67	27.89	6.79	4.68
Control Group	13.62	5.66	23.21	5.66	

Table 4 shows that the mean scores of Physics students taught with flipped classroom strategy(Experimental group) and that of those taught with the discussion strategy(control group) at post are 27.89 and 23.21 respectively. The table also shows that the difference in the means is 4.68. It can therefore be inferred that there is a difference in the performance mean scores of Physics students taught with flipped classroom strategy(experimental group) and that of those taught with the discussion strategy(control group) at posttest, and the experimental group has a higher mean than the control group.

Research Question 2: What is the difference between the mean performance scores of male and female Physics students taught with flipped classroom strategy at posttest?
Table 5: Analysis of mean scores of male and female Physics students taught with flipped classroom strategy at posttest

Gender	Pretest		Posttest		Mean Difference
	$\bar{x}$	SD	$\bar{x}$	SD	
Male	12.17	6.67	29.27	7.20	2.84
Female	12.57	5.66	26.43	6.14	

Table 5 shows that the mean scores of male and female Physics students taught with flipped classroom strategy at posttest are 29.27 are and 26.43 respectively. Table 5 also shows that the difference in the means is 2.84. It can therefore be inferred that there is a mean score difference in the performance of male and female Physics students taught with flipped classroom strategy at posttest, and male group has higher mean than the female.

Hypothesis 1: There is no significant difference between the mean performance scores of Physics students taught with flipped classroom and that of those taught with the discussion strategy at posttest.

Table 6: Result of ANCOVA testing the null hypothesis that there is no significant difference between the mean performance scores of Physics students taught with flipped classroom strategy and that of those taught with discussion strategy at posttest;

Source	type III Sum of Sq.	df	Mean Square	F-cal.	F-critical	LS	Prob.	Decision
Corrected Model	343.054[a]	2	171.527					
Intercept	4590.765	1	4590.765	7.843	5.02	0.05	0.06	Rejected
Pretest	25.717	1	25.717					
Method	335.115	1	335.115					
Error	3332.600	78	2.726					
Total	61329.000	81						
Corrected Total	3675.654	80						

Table 6 shows that the F-computed (7.84) is greater than F-critical (5.02), and the level of significance (0.05) is greater than the probability (0.01). Based on this, the researcher rejects the null hypothesis that there is no significant mean score difference in the performance of physics students taught with flipped classroom strategy and that of those taught with the discussion strategy at posttest. Therefore the alternative hypothesis is accepted.

Hypothesis 2: There is no significant different the mean scores of male and female Physics students taught with flipped classroom strategy at posttest;

Table 7: Result of ANCOVA testing the null hypothesis that there is no significant difference between the mean performance scores of male and female Physics students taught with flipped classroom strategy at posttest;

Source	Type III Sum of Squares	df	Mean Square	$F_{calculated}$	$F_{critical}$	LS	Probability.	Decision
Corrected Model	153.649[a]	2	76.824	1.708			.190	
Intercept	4465.497	1	4465.497	99.272			.000	
Pre1	33.232	1	33.232	.739			.394	
Grup1	125.981	1	125.981	2.801	5.02	0.05	.100	Accept
Error	2564.001	57	44.982					
Total	49255.000	60						
Corrected Total	2717.650	59						

Table 7 shows that the F-computed (2.80) is less than F-critical (5.02), and the level of significance (0.05) is less than the probability (1.00). This result leads the researcher to fail to reject the null hypothesis and conclude that gender has no moderating effect on the performance of Physics students who took part in the study.

Summary of findings

The study found out that the posttest mean of the experimental group (flipped classroom model of blended learning) is higher than that of the traditional (face-to-face classroom discussion) and that the mean difference is significant.

Gender did not have any significant effect on the performance of Physics student even though males seem to have higher mean scores at some points.

DISCUSSION OF FINDINGS

Performance of Physics students taught with flipped classroom and those taught with discussion strategy at posttest?

The result shows that the mean scores of Physics students taught with flipped classroom strategy and that of those taught with the discussion strategy at post are 27.89 and 23.21 respectively. This means that the difference in the mean scores is 4.68. Also statistical analysis shows that a significant difference exist between the means of the two strategies.

This result means that flipped classroom tends to be a better strategy than the (traditional) face to face strategy (discussion) as students taught with the flipped classroom strategy performed better.

The result that students taught with flipped classroom (blended learning) performed better is expected and is not a surprise. This is because research into teaching strategies involving multimedia use in teaching, engagement and collaborative learning as well as other 21st century approaches such as blended learning suggests that they are better approaches to learning more than the traditional approaches (de Sousa, Richter & Nel, 2017, Inceday, 2018).

This result is in line with the findings of Viktor and Fairuza(2017) in a study on the Particularities of blended learning implementation in teaching physics by means of LMS Moodle which found out that the use of blended learning for the study of physics in the Elabuga Institute of Kazan Federal University expanded educational opportunities for students by increasing the availability and flexibility of education, by taking into account their individual educational needs and by the rapidity of acquisition.

Effect of gender on the academic performance of physics students taught with blended learning at posttest

The result shows that the mean scores of male and female Physics students taught with blended learning strategy at posttest 29.27 are and 26.43 respectively. The mean difference is 2.84. Results of statistical analysis also shows that there is no significant gender difference in the performance mean scores of Physics students taught with the flipped classroom strategy at posttest. This means that even though the male students of the treatment group (blended learning) have a slight higher mean score than the females, the mean difference is not significant. This result is not surprising because it supports the assumption that males perform better in courses or subjects with mathematical operations and manipulations than the females though the difference is not statistically significant. This present result is in agreement with the findings of Clement and Femi's(2015) study on the influence of subject combination and gender on the achievement of Physics students at the Nigeria Certificate in Education (NCE) Level which revealed that sex is not a determinant of students' academic performance in Physics since according to the study, even though the mean CGPA of male was greater than that of female across NCE I, NCE II and NCE III, the differences were not found to be statistically significant ($p<0.05$) in all the cases. It also agrees with the findings of Alao and Abubakar(2010)as well as Kola and Taiwo(2013) but tends to disagree with the findings of Oluwatelure(2015) which revealed that there was a significant sex difference in the performance of students in science in secondary schools.

CONCLUSION

The following conclusions were made by the researcher:

1. The study found out that the posttest mean of the experimental group (flipped classroom model of blended learning) was higher than that of the traditional (face-to-face classroom discussion) and that the mean difference was significant. This means that the experimental group performed better at posttest meaning that blended learning tends to be a better strategy than the face-face strategy.
2. Gender did not significantly influence either the performance of Physics student even though males seem to have higher mean scores at some points. Therefore, that a student performs better in Physics is not a factor of whether the person is a male or female student.

Recommendations

The researcher recommends that:

1. Blended learning should be made a compulsory teaching strategy for Colleges of Education and similar institutions.
2. Compulsory professional training in the knowledge and use of ICT should be made a part of the teacher training programmes of schools such as Universities and Colleges of Education.
3. There should be a periodic training and retraining of teachers on 21st century teaching strategies such as computer and ICT based teaching strategies one of which is blended learning
4. Investments in digital teaching and learning materials is needed in our institutions of higher learning

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