
EFFECT OF FLIPPED CLASSROOM ON COMPUTER EDUCATION STUDENTS' ATTITUDE AND ACHIEVEMENT IN COMPUTER NETWORKING COURSE IN COLLEGES OF EDUCATION IN KANO STATE, NIGERIA

¹Lovina I. Eze & ²John E. Eze

¹Department of Computer & Robotics Education, Faculty of Vocational & Technical Education, University of Nigeria Nsukka

ifeomaezelov@gmail.com

²Department of Mathematics Education, School of Secondary Education Science, Federal College of Education (Technical), Bichi, Kano State

justusezeone@gmail.com

Correspondence: ifeomaezelov@gmail.com

Abstract

This study investigated the effect of flipped classroom on computer education students' attitude and achievement in computer networking in colleges of education in Kano state, Nigeria. This study adopted a quasi-experimental research design; a non-equivalent pre-test-post-test control group design in which intact classes were assigned to the experimental and control groups. The population of the study consisted of one hundred and twelve (112) computer education students from the two federal colleges of education in Kano State. The entire population of the study was used as the sample. Five research questions and five hypotheses guided the study. The instruments used for data collection consisted of a computer networking achievement test (CNAT) and computer networking attitude scale (CNAS). The instruments for data collection were subjected to face and content validation by research experts, from the Department of Computer and Robotics Education; University of Nigeria, Nsukka using table of specifications constructed for the multiple-choice test items. The multiple-choice test had average difficulty and discrimination indices of 0.39 and 0.52 respectively. The reliability coefficient for CNAT was computed using the Kuder-Richardson formula (KR-20) while that of CNAS was computed using Cronbach Alpha (α). The reliability coefficients for the CNAT and CNAS were 0.83 and 0.86 respectively. The data collected were subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS) version 23. The research questions were answered using descriptive statistics of mean and standard deviation while the hypotheses for the study were tested using t- test and the Analysis of Covariance (ANCOVA) with pre-test scores as covariates at 0.05 level of significance. Effect size (Eta-Squared) was used to determine how important any observed differences are. The findings from the study showed that flipped learning instructional strategy was more effective than the lecture method in improving students' academic achievement and attitude in computer networking. The result also shows that there was no significant difference between the achievement of male and female students from the experimental group in computer networking and that there was no significant interaction effects of treatment and gender on students' achievement and attitude in Computer networking. Based on the findings of the study, it was concluded that flipped learning approach is more effective than lecture method in improving student's achievement and attitude in computer networking. It was recommended among others that the Federal and State governments through the Ministry of Education should provide adequate ICT facilities and resources for effective implementation of flipped learning strategy in all Colleges of Education in Nigeria.

Keywords; Flipped Classroom, Attitude, Networking, Academic Achievement, Computer Networking

Introduction

Information is being produced, exchanged, and traced across the globe in real time. It is possible as almost everyone and everything in the digital world is interconnected through one way or the other. Parallel to the rapid development of information and communication technology, the demand for its use in schools and classrooms has increased (Tugun, 2016). Networking refers to a group of people who exchange information, contacts, and experience for professional or social purposes (Jain, 2023). A computer network is basically computers wired together in a way that lets them share data and devices such as hard drives, CD-ROMs, fax-modems, printers, etc. (Bharat, Rajesh & Ankit, 2021). Resources such as files, applications, printers and software are common information shared in a networking.

Computer networking is offered as a course of study in computer science and related or allied courses/programmes like computer engineering, computer and robotics education, computer science education, information science and information and communication technology among others. This is because, in this era of digital technologies, computer networking is regarded as a fundamental component of information technology (IT) systems (Bharat, Rajeh, & Ankit, 2021). Students who study computer networking as course in institutions of higher learning are required to acquire computer networking skills. The importance of computer networking in national development led to its integration into the minimum standards of the National Commission for Colleges of Education (NCCE, 2020). The Commission maintained that computer networking (CSC325) among other courses should be taught in the computer Education discipline in Nigerian colleges of education.

The teaching and learning of computer networking in colleges of education is a great challenge to both the teachers and the students. According to Santos, Figueiredo, & Vieira, (2019), the teaching and learning of computer networking are faced with the problem of inadequate skills and technical know-how by some lecturers and technologists in Nigerian colleges of education. The lecture teaching method often applied in the teaching of computer networking has become a great concern to the researcher. The students are not given chance for active participation in the process of constructing networking ideas where connected thoughts are involved. Literature has shown that the teacher-centered teaching method which dominates teaching in colleges of education today is heavily blamed for poor academic achievement in computer networking (Qaiser & Ishtiaq, 2014). To improve student academic

achievement in computer networking, there is need to involve innovative pedagogical approaches in teaching of Computer Networking that can guarantee inclusive learning capable of transforming the learning environment, content relevance, quality teaching and actual learning of computer networking.

Innovative pedagogy, according to Bordia (2022), involves the study of innovative teaching practices and their effects on the learning process. Nwangwu (2018) also posited that a teaching strategy becomes innovative when it is able to engage students in the learning process and helps them achieve better results without affecting or altering the educational objectives.

Innovative pedagogy in the context of this study would involve the application of the flipped learning strategy in teaching computer networking in Colleges of Education in Kano state, Nigeria. Flipped Learning (FL) is an instructional and learning model that consists of two parts: interactive group learning activities inside the classroom, and a direct computer-based individual instruction (Bishop & Verleger, 2013). Flipped learning according to Nwangwu (2018) is an inverted classroom instructional strategy whereby the teacher distributes a take home reading material such as video, podcast, document, PowerPoint slide, or web links to students so that they can study at their own time and pace, digest the material before coming to class. The flipped classroom demonstrate several advantages including improve students' learning (Li, Gao, Liu, & Sun, 2018), prompted the student's self-efficacy (Hwang & Lai, 2017, Kurt, 2017), enhanced learning experience and improved academic performance (Choi, Kim, Bang, Park, 2016) Flipped learning can motivate students to learn more effectively, develop critical thinking skills, facilitate collaborative learning, and handle different learning styles (Ibrahim & Emmrullah, 2019; Fetaji & Ebibi, 2019). Inability to adopt innovative pedagogical strategies in teaching and learning especially in computer networking could lead to poor academic achievement.

Academic achievement is the evaluation of one's performance of an academic task using grades and grading (Eze & Madu, 2022). Academic achievement means achieving a set academic target or goal (Ghanizadeh, 2017). Students in higher education are goal-oriented because for the student to graduate, the student must have satisfactorily passed all the courses expected of the student in the students' area of study. In the context of this study, academic achievement refers to extent of performance of students in computer networking course. The students' academic achievement is measured by using standardized or non- standardized test to provide valuable information. The adoption of teacher dominated teaching method especially in teaching and learning of computer networking, may cause a drop in students' attitude to learn and understand the learned content.

Attitude is important for decision making and engagement in an activity. This is in line with the popular saying that everyone is known for a particular attitude. Attitude is a psychological construct that determines one's approach and exposure to activities. Ezeudu and Gbendu (2021) viewed attitude as the response pattern(s) exhibited by humans as social beings. The term attitude has its root meaning from two Latin words *apro* (aptitude or fitness) and *acro* (posture of the body) both of which literally imply taking actions for one's position(s). Poor Attitude towards computer networking had therefore, been one of the major concerns of many researchers in the field of computer education. Perhaps, this is because it can be used to predict students' achievement and engagement in their future endeavors. Innovative strategies such as flipped classroom is therefore encouraged to enhance students' attitude towards computer networking.

The primary aim of this study therefore is to examine the effect of flipped classroom on attitude and achievement of NCE Computer Education Students in Computer Networking. The study also sought to determine the extent to which the use of flipped classroom affects the attitude and achievement of male and female students in Computer Networking.

Statement of the Problem

The teaching and learning of Computer Networking are faced with the problem of inadequate skills and technical know-how by some lecturers and technologists in Nigerian Colleges of Education. In addition to the problem of inadequate Computer Networking skills possessed by lecturers, the limited period of time allocated to hands-on courses coupled with large class size, inadequacy of facilities and teaching methods employed, contribute significantly to poor achievement of students in the acquisition of computer networking skills (Qaiser & Ishtiaq, 2014).

Teaching method such as flipped learning have undoubtedly been used in teaching other courses and have also been evaluated in terms of their influence on students' attitude and academic achievement in other studies. Though these strategies have been found to promote academic achievement among students in some disciplines, their effects on students' attitude and academic achievement in computer networking in Colleges of Education in Kano state, Nigeria, needs to be investigated. It is based on this premise that the researcher tends to conduct a study to determine the impact of flipped classroom on the attitude and academic achievement of students in computer networking in Colleges of Education in Kano state, Nigeria.

Objectives of the Study

The purpose of this study is to determine the effect of flipped classroom on computer education students' attitude and achievement in computer networking. Specifically, the study sought to:

1. Determine the effect of flipped learning on students' achievement in computer networking.
2. Analyze the effect of flipped learning on the achievement of male and female students in a computer networking.
3. Find out the interaction effect of treatment and gender on academic achievement of students in computer networking.
4. Find out the effect of flipped learning on students' attitude rating in computer networking.
5. Determine the effect of flipped learning on the male and female students' attitude in computer networking.

Research Questions

The following research questions were formulated for the study.

1. What is the mean academic achievement scores of students taught computer networking using flipped learning and those taught with lecture method?
2. What is the mean academic achievement scores of male and female students taught computer networking using flipped learning and those taught with lecture method?
3. What is the interaction effect of treatments and gender on the academic achievement of students in computer networking?
4. What are the mean attitude scores of students taught computer networking using flipped learning and those taught with lecture method?
5. What is the mean attitude- scores of male and female students taught computer networking using flipped learning?

Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught computer networking using flipped learning and those taught with lecture method.

2. There is no significant difference in the mean achievement scores of male and female Student taught computer networking using flipped learning.
3. There is no significant interaction effect of treatment and gender on achievement scores of students taught computer networking
4. There is no significant difference in the mean attitude scores of students taught computer networking using flipped learning and those taught with lecture method.
5. There is no significant difference in the mean attitude scores of male and female students taught computer networking using flipped learning.

Methodology

This study adopted a nonequivalent group quasi-experimental research design. Quasi-experimental design employs non-random criteria while assigning subjects to groups instead of randomly composed samples. The design is considered appropriate because the study involves the use of intact classes for the experiment in order to avoid the disruption of normal school arrangements and the program of activities in the colleges involved in the study.

The population for the study was 112 third year computer education students from the two Federal Colleges of Education in the State. This comprises of 52 and 60 NCE111 Computer Education Students of Federal College of Education (Technical), Bichi, and Federal College of Education Kano respectively in 2024/2025 academic session. The data was collected from the Examination and record office of the two colleges under study. The third-year students from two intact classes from the two Colleges of Education, was purposively sampled in this study. They are the level that offer Computer Networking (CSC325). The sample size consists of 52 (32 males & 20 females) and 60 (34 males & 26 females) students of Federal Colleges of Education (Technical), Bichi, and Federal College of Education Kano, respectively.

The instruments that were used for data collection in this study are Computer Networking Achievement Test (CNAT) and Computer Networking attitude Scale (CNAS). The CNAT was developed by the researcher from the National Commission for Colleges of Education (NCCE) curriculum content for Computer Networking course (CSC325) . The question items in CNAT is 30 multiple-choice items having four alternative options (A,B,C,D). CNAT was administered to the students to ascertain their level of mastery of instruction at the end of the course. The multiple-choice items were developed based on six levels of Blooms Taxonomy of the cognitive domain which includes comprehension, analysis, application syntheses among others. The researcher prepared a table of a specification to guide the development of the test items. Computer networking attitude Scale (CNAS) is a researcher-

developed 20-item instrument that is divided into two sections namely section A and B. Section A elicits information on the students' demographic data such as, students' gender while section B contains the structured 25-item statements designed to measure students' interest towards Computer Networking. CNAS is a modified four-point Likert type rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with corresponding numerical values of 4, 3, 2 and 1 respectively.

The instruments for data collection: CNAT and the lesson plans were subjected to face and content validation by research experts from the Department of Computer and Robotics Education from the University of Nigeria, Nsukka. A table of specification was developed and used in constructing the items in CNAT to ensure content validity. To ensure the reliability, the test was administered in a different school setting with different participants. The reliabilities of the multiple-choice test items and computer networking attitude scale were established using the coefficient of internal consistency based on Cronbach Alpha. The reliability coefficients for the CNAT and CNAS were 0.65 and 0.78 respectively. The difficulty and discrimination indices of the multiple-choice questions were also computed. While mean of item difficulty index was 0.41; mean of item discriminating index was 0.53. These values indicate that this test measures validly and reliably academic achievement of students.

The data collected from the pre-test and post-test scores were subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS). The research questions were analyzed using descriptive statistics of mean and standard deviation (SD) while hypotheses (1-3) were tested at 0.05 level of significance using ANCOVA. ANCOVA was considered to be appropriate for analyzing the difference between the initial effects of the treatment on the dependent variable. Again, since the research involved pre-test and post-test of intact classes, the statistical technique that was adopted for analyzing the hypotheses enabled the researcher to adjust initial group difference. Hypotheses (4 and 5) were tested using the independent sample t-test statistic in order to determine if there was a statistically significant difference in the mean interest rating scores of students. Effect size (Eta-Squared) was used to determine how important any observed differences are.

Results

Research Question One

What are the mean academic achievement scores of students taught computer networking using flipped learning and those taught with lecture method?

The data for answering research question one is presented in Table 1

Table 1. Mean and Standard Deviation of Pre-test and Post-test Mean Achievement Scores of Students in the Experimental and Control Group

Groups	Pre-test			Post-test		Mean Gain (M _g)
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	52	38.90	12.02	66.41	8.39	27.51
Control	60	36.82	7.03	54.28	6.37	17.46

Key: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation

The results shown in Table 1 indicate that the control group had a mean achievement score of 36.82 and a standard deviation of 7.03 in the pretest while the experimental group had a mean and standard deviation of 38.90 and 12.02 respectively. In the posttest, the mean achievement score and standard deviation of control group were 54.28 and 6.37 respectively while the mean achievement score and standard deviation of experimental group were 66.41 and 8.39 respectively. This result shows that the mean gain in experimental group and control group were 27.51 and 17.46 respectively. These results show that the students in the experimental group improved upon their computer networking achievement scores than the students in the control group as shown by their higher difference in the mean scores.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught computer networking using flipped learning and those taught with lecture method.

Table 2. Summary of ANCOVA for differences in the mean achievement scores of students based on method and gender

Sources of variation	Sum of squares	Df	Mean squares	F value	Sig. of F	Partial Eta Squared	Dec.
Corrected model	2442.418 ^a	4	860.604	46.576	0.000	.713	
Intercept	358.849	1	358.849	5.843	0.018	.072	
Pre- test	7193.462	1	7193.462	117.123	0.000	.610	
Group	429.328	1	429.328	6.990	0.010	.083	S
Gender	165.709	1	165.709	2.698	0.102	.035	NS
Method* Gender	53.972	1	53.972	0.879	0.352	.012	NS
Error	4606.332	107	61.418				
Total	248500.000	112					
Corrected Total	16048.750	111					

a. $R^2 = 0.713$ (Adjusted R squared = 0.610), S = significant, NS = not significant

Table 2 shows that there is a significant difference in the mean achievement scores of students taught computer networking by flipped classroom strategy and those taught by the lecture method, since $F(1, 107) = 6.990$, $p = 0.010 < 0.05$ and $\eta^2 = .083$. The eta-squared statistic (.083) indicated a substantial effect.

Research Question Two

What are the mean achievement scores of male and female students taught computer networking using flipped learning and those taught with lecture method?

The data for answering research question two is presented in Table 3.

Table 3. Mean and Standard Deviation of Pre- test and Post- test Mean Achievement score of male and female students' exposed to flipped learning approach and lecture method

Gender	N	Pre-test		Post-test		Mean Gain (M_g)
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	66	45.02	7.03	65.00	8.20	19.98
Female	46	47.25	8.24	64.35	6.37	17.10.

Key: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation

The results in table 3 revealed that male students had mean achievement score of ($\bar{x} = 45.02$, $SD = 7.03$) at the pretest and mean achievement score of ($\bar{x} = 65.00$, $SD = 8.20$) at the posttest with mean gain of 19.98. Also, the female students taught the same course had the mean achievement score of ($\bar{x} = 47.25$, $SD = 8.24$) at pretest and mean achievement score of ($\bar{x} = 64.35$, $SD = 6.37$) at posttest with a mean gain score of 17.10. The standard deviation for posttest is 8.20 for male students and 6.37 for female students, indicating that the values tend to be close but the mean gain shows that the male students performed better than the female students in computer networking. The higher achievement mean gain score of 19.98 for the male group over that of the female group (17.10) indicates that male students had slightly improved achievement towards computer networking than their female counterparts.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female Student taught computer networking using flipped learning.

Table 2 also shows that there was no significant main effect of gender on male and female students' achievement in computer networking since, $[F(1, 107) = 2.698$, $P = 0.102 > 0.05$] and partial eta squared (η^2) = .035. This means that male students did not achieve significantly

better than their female counterpart in computer networking course. Thus hypothesis 2 which states that there is no significant difference in the mean achievement scores of male and female students taught computer network students' achievement using flipped learning was therefore retained. This shows that gender was not a significant factor in determining students' achievement in computer networking

Research Question 3

What is the interaction effect of treatments and gender on the academic achievement of students in computer networking?

The data for answering research question three are presented in Table 4 .

Table 4: Mean Interaction Effect of Treatment and Gender on Achievement Scores of students in Computer Networking

Treatment	Gender	N	Pre-Test		Post-Test		Mean Gain
			X ₁	SD ₁	X ₂	SD ₂	
Flipped Learning	Male	32	47.71	8.33	70.42	8.98	22.71
	Female	20	50.23	6.15	70.40	8.13	20.17
Lecture Method	Male	34	43.16	6.65	64.20	5.60	21.04
	Female	26	44.14	5.56	60.15	5.23	16.01

Key: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation

The result shows the interaction effect of treatment and gender on achievement scores of students taught computer networking using flipped learning and lecture method. In the treatment, the result reveals that the male and female students taught computer networking using flipped learning had the achievement mean gain of 22.71 and 20.17 respectively. The male and female students taught computer networking using lecture method had achievement mean gain of 21.04 and 16.01. These shows that male students had greater achievement with higher gain scores in the two group.

Hypothesis 3

There is no significant interaction effect of treatment and gender on achievement scores of students taught computer networking.

Table 2 shows that gender did not interact significantly with method to influence students' achievement, since $F(1,107) = 2.698$, $P = 0.352 > 0.05$ and $\eta^2 = .012$. Thus hypothesis 3 which states that there is no significant interaction effect of treatment and gender on students' achievement in geometry was upheld. Moreover, since method by gender interaction was not significant, it follows that the difference in the mean achievement of male and female students was not due to method of instruction. The graph in figure1 indicates that there was no significant interaction effect of treatment and gender on achievement scores of students taught computer networking. This is apparent in the graph when the interaction-lines representing instructional methods and gender do not intercept at a point as shown in Figure 1.

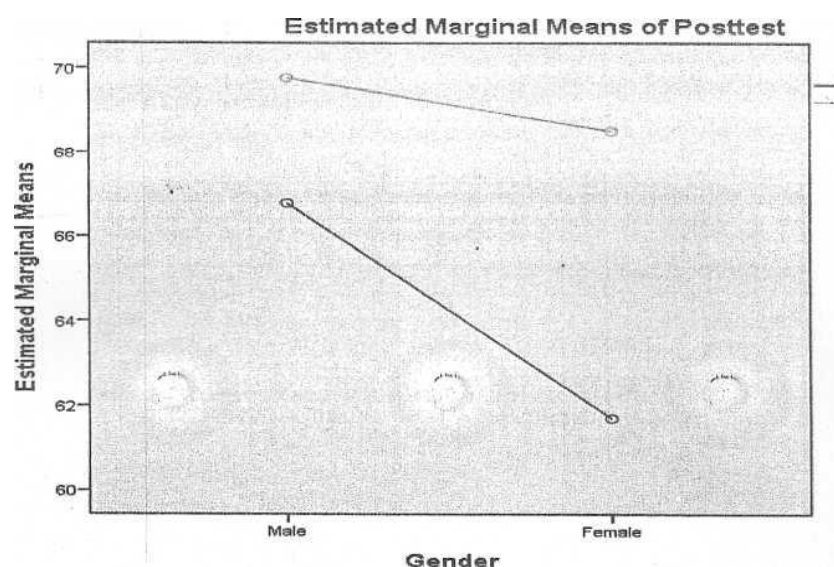


Figure 1: Graphical Representation of Interaction Effect of Treatment and Gender on Mean gain in Achievement Scores

Research Question 4

What is the mean attitude scores of students taught computer networking using flipped learning and those taught with lecture method?

The data for answering research question four is presented in Table 5.

Table 5 shows that flipped learning approach score at pretest is ($\bar{x} = 53.42$, $SD = 5.06$) and the posttest mean score of ($\bar{x} = 65.78$, $SD = 7.73$) with a mean gain of 12.36. Also, the students taught the same course using lecture method had the mean score of ($\bar{x} = 51.30$, $SD = 5.21$) at the pretest, mean and standard deviation score of ($\bar{x} = 56.98$, $SD = 5.34$) at posttest with a

mean gain score of 5.68. The higher mean gain score of 12.36 for flipped learning imply that flipped classroom approach was more effective in enhancing students' mean attitude scores in computer networking than the lecture method.

Table 5. Mean and Standard Deviation of Pre-test and Post-test Mean attitude Scores of Students in the Experimental and Control Group

Groups	Pre- attitude test			Post- attitude test		Mean Gain (M _g)
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	52	53.42	5.06	65.78	7.73	12.36
Control	60	51.30	5.21	56.98	5.34	5.68

Key: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation

Hypothesis 4

There is no significant difference in the mean attitude scores of students taught computer networking using flipped learning and those taught with lecture method.

Data for testing the research hypothesis 4 is presented in Table 6

Table 6. T-test comparison of the post-test mean attitude scores of students in the experimental and control group

Group	N	Mean	SD	Df	t-value	P-value	η^2
Experimental	52	65.78	7.73	110	1.66	0.001	0.08
Control	60	56.98	5.34				

Table 6 shows that there is significant difference between the experimental group students' attitude gain scores (M=65.78; SD=7.73) and the control group students' attitude gain scores (M=56.95; SD=5.34) in favor of experimental group ($t(110)= 1.66$; $p = 0.001 < 0.05$), η^2 of this difference was calculated as 0.08. This value indicates that flipped classroom has medium effect on attitude towards computer networking compared to lecture method.

Research Question 5

What is the mean attitude- scores of male and female students taught computer networking using flipped learning?

The data for answering research question five is presented in Table 7.

The result in Table 7 shows that the male students who were taught computer networking using flipped learning method had mean attitude score of ($\bar{x} = 56.05$, $SD = 5.47$) at the pretest

and the mean attitude score of ($\bar{x} = 68.71$, $SD = 6.02$) at the posttest with mean gain of 11.68. On the other hand, the female students had the mean attitude score of ($\bar{x} = 53.10$, $SD = 5.32$) at pretest and mean interest score of ($\bar{x} = 63.50$, $SD = 5.23$) at posttest with a mean gain score of 10.40. The result shows that that the male students showed more positive attitude in Computer networking.

Table 7 Mean and Standard Deviation of Pre- attitude test and post-attitude test Mean score of Male and Female students exposed to flipped learning approach

Gender	N	Pre-test		Post-test		Mean Gain (M_g)
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	66	56.05	5.47	68.71	6.02	11.68
Female	46	53.10	5.32	63.50	5.23	10.40

Key: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation

Hypothesis 5:

There is no significant difference in the mean attitude scores of male and Female students taught computer networking using flipped learning.

Table 8. t- test comparison of the mean attitude scores of students in the experimental group based on gender

Gender	N	Mean	SD	Df	t-value	P-value	η^2
Male	66	68.71	6.02	110	1.66	0.103	0.032
Female	46	63.50	5.23				

The results in table 8 shows that there was no significant main effect of gender on students' attitude in computer networking since, $t_{(110)} = 1.66$, $P = 0.103 > 0.05$ and $\eta^2 = 0.032$. This means that male students did not achieve significantly better than their female counterpart in computer networking. Thus, hypothesis 5 which states that there is no significant main effect of gender on students' attitude in computer networking was therefore upheld.

Discussion

The results of the study are discussed based on the research questions answered and the hypotheses tested. The findings of the study on research question one showed that there is a mean difference between the pretest and posttest scores of students' achievement in

computer networking when taught with flipped learning. Inference drawn from the hypothesis tested is that there is a significant in the mean achievement scores of students in the treatment group. This finding is also similar to the findings of the study about the positive impact of flipped learning on students' success (Ibenegbu & Ugwu, 2022; Ezeudu & Gbendu, 2021 ; Choi, Kim, Bang, Park, Lee, & Kim, 2017; Duygu & Ali , 2018) which justified according to the different benefits of the FL model such as the flexibility in time and place, support the student-centered approach, differentiate the learning experience, self-paced study, the diversity of resources, enjoyable environment and self-assessment.

Findings of the study from the research question two revealed that the male students have higher achievement mean gain when taught computer networking with flipped learning approach than the female students. Inferences drawn from the hypothesis tested showed no significant gender difference on students' mean achievement scores in computer networking. This finding was consistent with the finding by (Charles- Ogan, 2014; Eze, 2023) who indicated in their studies that there were equivalent numbers of male and female students with mathematics disability. This result also falls in line with the positions of (Ibenegbu & Ugwu, 2022; Ezeudu & Gbendu, 2021) who debunked the idea of gender differentiation in ability.

The findings of the study on research question three which deals with the interaction effect of mode of instruction and gender on students' achievement scores in computer networking revealed that male students had greater achievement with higher gain scores in the two group. The study was supported by the study of Salimiand Yosefzadeh (2015) which examined the effect of flipped classroom on students' achievement at the secondary level in Ardabil. This result is also consistent with the findings of (Ibenegbu & Ugwu, 2022) who reported that gender did not have any significant interaction effect on the achievement scores of students taught government using flipped learning instructional strategy. Since method by gender interaction was not significant, it follows that the difference in the mean achievement of male and female students was not due to method of instruction.

The findings of the study on research question four showed that there is a mean difference between the pretest and posttest scores of students' attitude gain in computer networking when taught with flipped learning. Inferences drawn from the hypothesis tested revealed that there is a mean difference between the pretest and posttest scores of students' attitude gain in computer networking when taught with flipped learning. The results are similar to the results of the studies conducted by Abeysekera and Dawson (2015), Wael, Aseel and Nayel (2020) who showed that flipped learning promoted positive attitudes towards mathematics class and increased motivation due to increase of social interaction,

The findings of the study in research question five revealed that the male students have higher interest gain than female students when taught with flipped learning. Inferences from the hypothesis tested showed no significant gender-difference on students' mean interest scores in computer networking. This could be attributed to the equal learning opportunities that were provided to both male and female students in the flipped learning group. The finding is in agreement with the study conducted by (Ozyurt&Ozyurt,2017; Karadag & Keskin, 2017) which shows that the majority of students express positive interest towards flipped learning.

Conclusion.

The continuous poor performance and quality of Nigerian graduates are causing a great deal of concern to stakeholders in the Nigerian education sector and the society at large irrespective of the tremendous advance of information and communication technology usage in teaching and learning. Currently, computer-mediated communication has proliferated within teaching and learning in higher education settings considering its impact on the academic achievement and social integration of students. Based on this note, this study was sought to determine the effect of flipped learning approach on students' academic achievement and attitude in computer networking in colleges of education in Kano State, Nigeria. Based on the findings of the study, it was concluded that flipped learning approach is more effective than lecture method in improving student's achievement and attitude in computer networking. These high achievement gains recorded in flipped learning approach is attributed to the level of student's pace learning, flexibility, and virtual learning, increased mentoring of students which makes the students active participants in a computer networking class.

Recommendations

Based on the findings made and conclusions drawn from the study, the following recommendations were made.

1. The Federal and State governments through the Ministry of Education should provide adequate ICT facilities and resources for effective implementation of flipped learning strategy in all Colleges of Education in Nigeria
2. Computer Education lecturers should be encouraged to adopt the use of flipped learning in their day-to-day teaching activities. Hence, it will help to introduce a wider variety of innovative strategies into their teaching styles
3. The education ministries at all levels, curriculum planners and policy makers should

ensure constant curriculum evaluation and review that will ensure the production of qualified Computer Education graduates in Colleges of Education in North-west, Nigeria.

4. Federal and State Governments in collaboration with Ministries of Education should organize and sponsor regular training workshops and conferences to train lecturers on how to promote computer networking instruction through the use of innovative flipped classroom strategy.

References

- Abeysekera, L. & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1–14.
- Bharat, P., Rajesh, K. J. & Ankit, K. T. (2021). *World Journal of Research and Review (WJRR)* 12(6), 33-36.
- Bishop, J. L., & Verleger, M.A. (2013, June). The flipped classroom: A survey of the research. In 120th American Society of Engineering Education National Conference Proceedings, Atlanta, GA. Paper #6219
- Bordia, D.A. (2022). Innovative pedagogy - A guide. <https://blog.teachmint.com/innovative-pedagogy-a-guide>
- Charles-Ogan, G. (2014). Metacognitive strategy and senior secondary school Mathematics students' misconceptions in Rivers state. *Journal of Mathematical Association of Nigeria(JMAN)*.39(1), 234 – 246.
- Choi, H., Kim, J., Bang, K., Park, Y., Lee, N., & Kim, C. (2017). Applying the flipped learning model to an English-medium nursing course. *Journal of Korean Academy of Nursing*, 45(6), 939-948. <https://doi.org/10.4040/jkan.2015.45.6.939>
- Duygu, S. & Ali,A. (2018). The Effect of Flipped Classroom on the Academic Achievement And Attitude of Higher Education Students. *World Journal of Education* 8,(4); URL:<https://doi.org/10.5430/wje.v8n4p170>. Retrieved, 8th January, 2023
- Eze, J. E. & Madu, C.I. (2022). Effects of concept- mapping Instructional strategy on secondary Students' interest and achievement in geometry in Bichi Educational Zone, Kano State, Nigeria. *Watari Journal of Science and Technology Education*, 6(1),13-27.
- Ezeudu, S.A & Gbendu, G. O. (2021). Effect of flipped classroom strategy on students' attitude towards secondary school geography: implications for entrepreneurship education in Nigeria. *International Journal of Studies in Education*. 16(2), 38-51.
- Fetaji, M., Fetaji, B. & Ebibi, M. (2019). Analyses of possibilities of flipped classroom in teaching computer science courses. *IEEE*, 747-752.
- Ghanizadeh, A. (2017). The interplay between reflective thinking, critical thinking, self-monitoring, and academic achievement in higher education. *High Education* 7(4);101-114
- Hwang, G. J. & Lai, C. L. (2017). Facilitating and bridging out-of-class and in-class

- learning: An interactive e-book-based flipped learning approach for math courses. *Journal of Educational Technology & Society*, 20(1), 184.
- Ibenegbu, C.I. & Ugwu, K. (2022). Effects of Flipped Classroom Approach on Students Achievement in Government in Nsukka Education Zone, Nigeria. Available online at
DOI: <https://doi.org/10.21203/rs.3.rs-1633688/v1>
- Ibrahim, K. & Emrullah, E. (2019). The effect of flipped learning approach on academic achievement: A meta-analysis study. *Hacettepe University Journal of Education*, 34(3), 708-727.
- Jain, S. (2023). *Types of computer networks*. <https://www.geeksforgeeks.org/types-of-computer-networks/>.
- Karadag, R. & Keskin, S. S. (2017). The effects of flipped learning approach on the academic achievement and attitudes of the students. *New Trends and Issues Proceedings on Humanities and Social Sciences*. [Online]. 4(6), 158-168. Available from: www.prosoc.eu
- Kurt, G. (2017). Implementing the flipped classroom in teacher education: Evidence from Turkey. *Educational Technology & Society*, 20(1), 211–221
- Li, C., Gao, J., Liu, S., & Sun, G. (2018). Flipped classroom based on e-learning in computer science and technology: A case study. In *International Conference on E-Learning, E-Education, and Online Training* (pp.330-337). Springer, Cham. https://doi.org/10.1007/978-3-319-93719-9_45
- Malai, S.A. (2012). *Introduction to networking*. <https://www.researchgate.net/publication/https://www.researchgate.net/publication>.
- NCCE, (2020). *Nigeria certificate in education minimum standard for sciences*, 2020 Edition.
- Nwangwu, E.C. (2018). Innovative ideas and strategies for effective teaching and learning of computer science education in higher education. In U. Agwaga (Eds). *Emerging issues in science and vocational education*. God' Will Prints Enterprise.
- Ozyurt, O. & Ozyurt, H. (2017). A qualitative study about enriching programming and algorithm teaching with flipped classroom approach. *Pegem Journal of Education and Instruction*, 7(2), 189–210.
- Qaiser, N. & Ishtiaq, B. (2014). Effect of classroom physical environment on academic achievement scores of secondary school students in Kohat division, Pakistan. *International Journal of Learning and Development*. 4(1);71-82.
- Wael, I. S., Aseel, O. A. & Nayel D. A. A. (2020). The Impact of Integrating Flipped Learning and Information and Communication Technology on the Secondary School Students' Academic Achievement and Their Attitudes Towards It. *International Education Studies*; 13(2). <https://doi.org/10.5539/ies.v13n2p1>
- Salimi, A., & Yousefzadeh, M. (2017). The effect of flipped learning (revised learning) on Iranian students' learning outcomes. *Advances in Language and Literary Studies*, 6(5), 209-213