EFFECT OF MEPLN E-LEARNING ARCHITECTURE ON NCE III STUDENTS' PERFORMANCE IN NETWORKING IN COLLEGES OF EDUCATION, BENUE STATE

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Abstract
Smart phones have become ubiquitous among students of higher education. This has generally been considered a source of diversion from their studies as they are usually found enamored their devices, sometimes with ear phones plugged to keep the world out. This phenomenon can be converted to a potential with the rising need for imbibing e-learning as a panacea to most of the challenges facing education in Nigeria and beyond. The study, sought to leverage this general possession of smartphones among students of Colleges of Education Benue state. To do this, MEPLN e-learning was employed to teach "introduction to networking". The population of study was 340 students of NCE III taking the course in the seven Colleges of Education in the state. Two of the Colleges were randomly sampled for the study, with a combined sample of 82 students taking the course. The study was a experimental design.The research questions were answered using mean and standard deviation. The hypotheses were tested using ANCOVA at 0.05 level of significance. It was found that the students performed better in the courses taught using conventional lecture methods than in the course where MEPLN e-learning was employed. Reasons were adduced for this uncharacteristic result in the discussion and conclusion, and recommendations made. It was also found that there was no significant effect of methods and gender

Keywords: MEPLN, e-learning, peer-to-peer, motivation, Infrastructure.

Introduction.

Online learning, or electronic learning, often written as e-learning, has become a global concept in the field of education. Apart from the interruption of educational and social life hoisted upon the world by the recent COVID-19, other reasons abound why the discussion of e-learning has taken central position in academia in recent years. As a result of global discussion of the concept originating from different parts of the world, there exists an endless number of synonyms for e-learning (Turnbull, Chugh and Luck, 2019; Singh Thurman, 2019).

E-learning may be defined as learning that employs digital gadgets (laptops, IPads, IPhones, Android handsets, interactive white boards, e.t.c.) along with networking facilities. Ellis, Ginns, and Pigott (2009) define online learning as information and communication technologies (ICTs) applied to aid students improve learning. According to Oblinger and Hawkins in Arkorful and Abaidoo (2015), e-learning is the use of technology to deliver part or all of a course without the constraints of time and place. Mahoney and Cameron (2018) posit that e-learning may also be known as web-based learning, online learning, assisted instruction, e-tutoring, assisted learning, course management systems, online teaching, and a plethora of other terms. No matter the term used, the role of e-learning sustaining education at all levels

under current global constraints cannot be emphasized. This important role was underscored by COVID-19, the pandemic that necessitated interruption to usual social life in schools, markets, worship places, and clubs. Societies which had no preparation for e-learning closed down everything including schools. In Nigeria for example, schools remain closed and educational activities like teaching, lecturing, conferences, symposia, seminars, project defense, all came to a halt. At the same time, Turkey and other industrialized nations which had the necessary infrastructure and the human capital and related competencies for e-learning simply transmuted to the e-learning paradigm and moved on with their schools' educational activities(Ersin, Atay Mede 2020). It therefore becomes clear, that unless Nigeria and other developing nations quickly catch on to e-learning, the whole of education and all its goals in those countries will suffer major drawbacks, or even possibly crash down completely. This will disadvantage its citizens in the growing global economy, as they would lack the skills and competencies required for global employability and sustained useful interrogation of society, not only on the global scale but also in Nigeria.

In Nigeria in particular, the reasons that necessitate transmutation to the e-learning paradigm are rife. Among these is a burgeoning youth population that cannot be absorbed by the. According to Abdulmajeed, Joyner and McManus (2020), yearly undergraduate admission takes only about 5.2% to 15.2% of applicants into Universities.This leaves out about 84.7% to 94.8% of candidates who are unable to get into Universities even though qualified. This large deficit of physically limited educational spaces to accommodate a willing population can easily be alleviated by e-learning.

Beyond the limited infrastructure in our Universities, security challenges relating to activities of cultists, kidnappers, bandits, rampant assassinations of lecturers and students, high risk of travel on poorly maintained roads, and now high transport costs arising from the removal of oil subsidies are all factors that cry out loud for Nigeria to urgently imbibe-learning. Imbibing e-learning however comes with its list of challenges Abdulmajeed et al (2020) report that there is a need to train Teachers in online instruction delivery skills and competencies, familiarize students with digital tools, empower staff and students for acquisition of necessary gadgets, obtain manpower for troubleshooting technical issues and upgrade networking infrastructure. None of these challenges can be overcome in a hurry. But to sit down and wait for perfect conditions is not a feasible alternative. It becomes necessary to start e-learning and improve over the years as conditions improve. There must be a way to circumvent the daunting challenges and move on; especially the intensive challenge of infrastructural deficit.

One of the ways to circumvent the daunting challenge of infrastructural deficit is the based peer-to-peer (p2p) collaborative e-learning systems for limited capacity networks (MEPLN) proposed by Ojo, Ajayi, Orenuga and Oluwatope (2018). The concept facilitates creativity and critical thinking by making learning an interactive venture between teachers and students. Under MEPLN, the based architectures of conventional e-learning approaches are substituted by p2p e-learning, in which both the teacher(s) and students act simultaneously as knowledge providers and knowledge consumers. All are accessible to one another, and the knowledge database is commonly accessible to all. The possibility of a limited capacity network is factored in by making the e-learning scenario asynchronous. In this research, no new infrastructure or e-learning platform is sought beyond what is already in general use in the environment of the Teacher and students, to wit, one of the popular social networking platforms.

Social networking platforms are not new or strange to students of any higher institution in Nigeria these days. The ubiquitousness of handsets among students has been highlighted by Oladosu et al (2020). In the study, it was found that students actually concentrate on their handsets much more than they do on their lectures and other class work, leading to technostress

and decreased achievement in class. However, Socuoglu and Andrew (2022) report an increase in performance grades when mobile devices were employed as tools for learning. It therefore becomes clear, that the possession of handsets among students can be harnessed to become tools for learning, instead of allowing them to function as distractions from learning. This researcher therefore employed WhatsApp to implement MEPLN e-learning. Apart from being one of the most popular networking platforms in the area of study, WhatsApp also supports the p2p e-learning architecture, as against other e-learning scenarios in Massive Open Online Courses (MOOCs) and Learning Management Systems (LMSs) which run on the server based e-learning architecture. The implementation of MEPLN e-learning was done in Colleges of Education in Benue state.

Fig. 1: Schema of MEPLN e-learning.
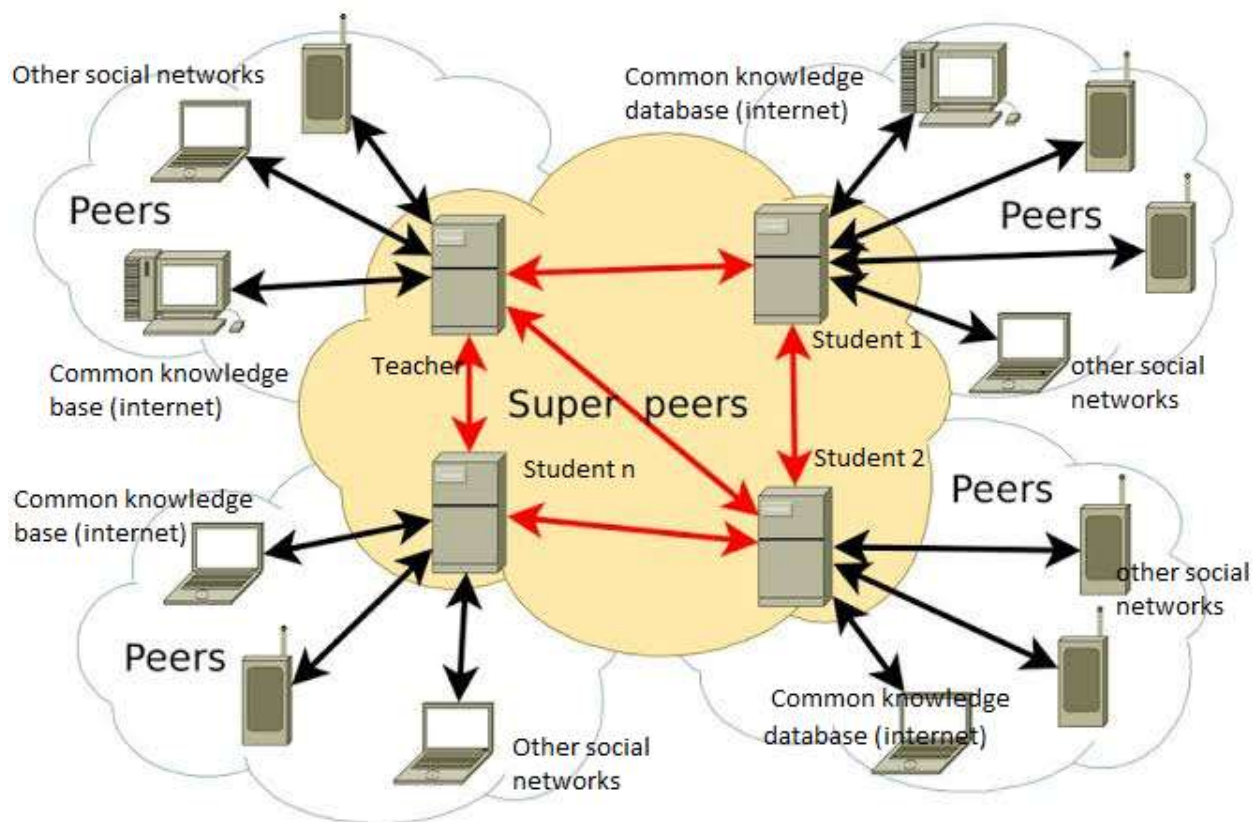
Adapted from Tran, Nguyen, and Ha (2015)

Benue is one of seven states in the North Central geopolitical zone of Nigeria (Baanu et al, 2018; Okorie et al 2013). According to the National Commission for Colleges of Education [NCCE] 2023), Benue has two state owed, four private and one Federal College of Education. The state owed Colleges of Education include College of Education Katsina-Ala, and College of Education, Oju. Both Colleges are structured into Schools, under which Departments operate. The Department of Co,puter Education falls under the School of Sciences (SCS) in both Colleges and offers same courses and course content as stipulated by the NCCE (2012). The Department of Computer Education, in which this research was domiciled, run six courses in the second semester of NCE III. The courses are coded as CSC 321, CSC322, CSC323, CSC324, CSC325 & CSC326. For this study, CSC 325, titled Introduction to Networking was used.

The objectives of stated for CSC 325 by NCCE (2012) are that by the end of the course, students should be able to explain information communication technology (ICT) and the importance of networking, explain at least two communication protocols, and identify and explain at least four networking tools. Others are for students to be able to explain the advantages and disadvantages of any three network topologies, differentiate between LAN and WAN networks; and use internet and intranet. To achieve these objectives, the minimum course content is given as meaning and nature of ICT, definition and importance of computer networking. Also to be included are: networking topology (characteristics, advantages and disadvantages of each), types of topology (star, ring, bus, tree and mesh), and networking types (LAN and WAN). Others are network tools (modems, servers, ISPs, etc), the use of internet and intranet, multiplexing and communication protocols, and finally network media. The instrument for data collection was based on these objectives and guided by the course content as shown in NCCE (2012).

LITERATURE REVIEW

E-learning, has generated interesting results in research over the years. For example, Onah, Uzoegwu, Ezenma, Okeke and Eze (2022) conducted research on the impact of web-based learning tools in instructional delivery of computer programming in Universities in developing countries. The results showed major distinctions in mean achievement scores in favor of learners trained on V-basic programming using web-based learning over those trained in the same course via traditional teaching methods. Also, Idowu (2023) in a study on efficacy of peer-to-peer learning strategy on English language college students' social and academic achievement in Oyo and Osun states, Nigeria made similar conclusions. In the study, significant differences were reported in favor of peer-to-peer learning compared to the traditional teacher-centered instructional methods. Furthermore, Idowu (2023) also reported significant differences in the post social life of students exposed to peer-to-peer learning above those in the traditional methods.

The study conducted by Ala et al (2021) on leveraging integrated peer-assisted learning clusters as a support for online learning covered learning clusters in universities in Harbin, China; and Akure, Nigeria. It was found that p2p e-learning improved learning interaction among students by up to 94% in Harbin, and up to 83.6% in Akure with significant increase in learning achievement of desired learning outcomes in both clusters of learners. The relative lower comparative increases in Akure were explained by constraints of power issues, narrow bandwidth, access to technology, academic staff motivation and low income levels in the Akure cluster. On the issue of motivation, Itasanmi et al (2022) conducted a study on Academic Staff's Motivation for Online Teaching in Nigerian Universities: Empirical Evidence from the University of Ibadan. The study found that individual and group training opportunities, introduction to new technology, institutional expectation (translated as manageable workloads and commensurate remuneration), and student enrolment are among the factors that motivate teachers for online knowledge delivery.

In another study conducted by Abdulmajeed et al (2020) on challenges of online learning in Nigeria, a comprehensive analysis of the challenges was provided. Divided into four major subheadings, the challenges were grouped under ICT infrastructural, Socioeconomic, sociocultural, and opinion challenges. ICT infrastructural challenges were enumerated as availability and quality of internet service, means of obtaining digital devices, competencies for technical support, familiarity and duration of exposure to online learning, experience with social media, skills in digital literacy, and issues of power supply. Among the socioeconomic challenges, income levels, family size and level of vital expenditure needed for survival,

alternative income sources, family status, parental education, geopolitical zone, family lifestyles, access to supporting materials and academic competence were listed. Motivation, gender alignment, age group, religion & levels of tolerance, cultural beliefs about technology, ability to communicate in the language of the internet, and dexterity with the use of technology form the sociocultural challenges. Finally, Abdulmajeed et al. (2020) provide the challenges under opinion as belief in MOOCs, preference of the population to classroom vs online learning, availability of online tools, discipline to control distractions, health challenges common in the population, justification for cost of MOOCs, familiarity with MOOC platforms, and student-teacher relations.

An unusual result was reported by Oladosu et al. (2020) in the study titled learning with smart devices: influence of technostress on undergraduate students' learning at University of Ilorin, Nigeria. The study found that the use of smart devices in learning creates technostress among undergraduate students, thereby negatively influencing their learning with the devices. The author argues that students with access to smart devices generally do not use the devices for learning purposes only, but also create addictions to social networking for entertainment or other less useful purposes, leading to compulsive behaviors and loss of interest in learning. However, investigating on "Social network media in a distance learning environment for e-learning and p2p support: the Nigeria distance learning project", Ozoh, Olurotimi, Ozoh, Ibukunolu and Olufunke (2012) report that social media platforms can be re-envisioned as supports for improved student learning outcomes. However, the study also shows a preference for the integration of periodicf2f student-teacher interaction with online learning.

In summary, therefore, related empirical literature shows that p2p collaborative e-learning, such as envisioned in MEPLN, results in the improved achievement of educational objectives among students. Besides, it also enhances better social interaction between participating groups outside and beyond the learning. However, many factors combine to make this possible, with many mitigating challenges. The mitigating challenges are summarized as ICT infrastructural.

PURPOSE OF STUDY

The main purpose of this study is to determine the effect of MEPLN e-learning architecture on NCE III students' performance in introduction to networking in the Colleges of Education in Benue State. Specifically, the study sought to determine:

1. The mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method
2. The mean score of the students about networking before any teaching was done
3. Compare the mean score of the students before teaching in the locations where the Colleges of Education are sited.

RESEARCH QUESTIONS

Three research questions were raised to guide the study:

1. What is the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method?
2. What is the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method?
3. What is the interaction effect of treatment and gender on the mean score of students in introduction to networking?

Hypotheses

Four null hypotheses were formulated and tested at 0.05 level of significance.

Ho$_1$: There is no significant difference the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method.

Ho$_2$: There is no significant influence of gender on the mean score of students in introduction to networking.

Ho$_3$: There is no significant interaction effect of treatment and gender on the mean score of students in introduction to networking.

METHODOLOGY

Design of the Study

The study used retest-posttest nonequivalent control group quasi-experimental research design

Population of Study

The population of the study is made of 82 students of State owed College of Educations in Benue state, comprising 34 NCE III students of the Computer Education Department, SCS, COE-K and 48 NCE III students of Computer Education Dept in SCS, COE, Oju in the 2020/2021 session.

Sample and Sampling Technique

There was no sampling as the population was small and manageable. Both classes were taken as an intact group for the study.

Instrument for Data Collection

The instrument used to administer the pre-test and post-test was a multiple choice question paper called the Assessment of Knowledgeable in Networking **(AKiN) questionnaire. It consisted of 40 questions covering the objectives and course content for networking in NCE III.**

Validation of the Instrument

The instrument was face validated by two specialists in Akperan Orshi Polytechnic, Yandev.

Reliability of the Instrument

The instrument was calculated using split halves method. It yielded a reliability coefficient of 0.82.

Method of Data Collection (Experimental)

The instrument was served to the students in both schools at the approximately same time under strict supervision akin to exam supervision. Their scores were recorded. After a week teaching interval, in which one school was taught using CLM, and the other taught networking using MEPLN e-learning, the same AKiN questionnaire was served to students, again, at approximately the same time. The student's scores in this second test were also recorded for both schools. The records of scores so obtained in the two schools became the data for the study.

Method of Data Analysis

The research questions were answered using means, while the formulated hypotheses were tested using ANCOVA at 0.05 level of significance.

Results

Research Question One: What is the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method?

Table 1: Pretest and Posttest mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method

SN	Treatment Groups	N	Pretest $\bar{X}$	Pretest SD	Posttest $\bar{X}$	Posttest SD	Mean Difference
1	MEPLN (Treatment Group)	33	54.48	14.48	71.64	11.36	17.16
2	Lecture Method (Control Group)	49	45.43	12.90	63.29	12.16	17.86

The results of the study as presented in Table 1 show that the experimental group taught introduction to networking using MEPLN method had a mean score and standard deviation of ($\bar{x}$ = 54.48, SD = 14.48) at pretest and a mean score and standard deviation of ($\bar{x}$ = 71.64, SD = 11.36) at posttest. The difference between the pretest and posttest of the experimental group was 17.16. Results also show that the control group taught introduction to networking without MEPLN had a pretest mean and standard deviation of ($\bar{x}$ = 45.43, SD = 12.90) and a posttest result of ($\bar{x}$ = 63.29, SD = 12.16). The difference between the pretest and posttest scores of the control group was 17.86. This result shows that the control group performed slightly better than the experimental group judging from the mean difference. The implication is that the MEPLN method was not better than the conventional lecture method.

Ho₁: There is no significant difference between the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method.

Table 2: Analysis of the Covariance (ANCOVA) of the difference between the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2209.682[a]	4	552.420	4.089	0.005	0.175
Intercept	18162.666	1	18162.666	134.434	0.000	0.636
Pretest	404.538	1	404.538	2.994	0.088	0.037
Treatment	468.554	1	468.554	3.468	0.066	0.043
Gender	150.350	1	150.350	1.113	0.295	0.014
Treatment * Gender	271.524	1	271.524	2.010	0.160	0.025
Error	10403.062	77	135.105			
Total	376835.000	82				
Corrected Total	12612.744	81				

The result of the study as presented in Table 2 shows that the following results were obtained, F (1, 77) = 3.468, p = 0.07, η^2_p = 0.043). Since the p-value is greater than 0.05 set as level of significance for testing the hypothesis, this means that the result is not significant and inference drawn is that the difference between the mean score of students taught introduction to networking using MEPLN e-learning and those taught using the conventional lecture method is not statistically significant. The partial eta squared value of 0.043 means that the treatment was able to explain only 4.3% of students' achievement in introduction to networking. In other words, the result shows that 4.3% of students' score in introduction to networking was influence or account for by the treatment.

Research Question Two: What is the influence of gender on the mean score of students in introduction to networking?

Table 3: Pretest and Posttest mean scores of the influence of gender on students' achievement in introduction to networking

SN	Gender	Pretest N	$\overline{X}$	SD	Posttest $\overline{X}$	SD	Mean Difference
1	Male	57	48.40	14.55	67.14	12.74	18.74
2	Female	25	50.60	13.51	65.52	12.03	14.92

The results of the study as presented in Table 2 show that the male students had a pretest mean and standard deviation scores of ($\bar{x}$= 48.40, SD = 14.55) and a posttest mean and standard deviation scores of ($\bar{x}$ = 67.14, SD = 12.74), the difference between the mean scores for the male students in introduction to networking was 18,74. The results also show that the female students had pretest mean and standard deviation scores of ($\bar{x}$ = 50.60, SD = 13.51) and a posttest mean and standard deviation scores of ($\bar{x}$ = 65.52, SD = 12.03), the difference between the pretest and posttest scores was 14.92. This result clearly shows that the male students perform better than the female students in introduction to networking.

Ho2: There is no significant influence of gender on the mean score of students in introduction to networking.

Table 4: Analysis of the Covariance (ANCOVA) of the influence of gender on students achievement in introduction to networking

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2209.682ᵃ	4	552.420	4.089	0.005	0.175
Intercept	18162.666	1	18162.666	134.434	0.000	0.636
Pretest	404.538	1	404.538	2.994	0.088	0.037
Treatment	468.554	1	468.554	3.468	0.066	0.043
Gender	150.350	1	150.350	1.113	0.295	0.014
Treatment * Gender	271.524	1	271.524	2.010	0.160	0.025
Error	10403.062	77	135.105			
Total	376835.000	82				
Corrected Total	12612.744	81				

The result of the study as presented in Table 4 shows that the following results were obtained with regards to the influence of gender on students' achievement in introduction to

networking, F (1, 77) = 1.113, p = 0.29, η^2_p = 0.014). Since the p-value is greater than 0.05 set as level of significance for testing the hypothesis, this means that the result is not significant, and inference drawn is that the difference between the mean score of male and female students taught introduction to networking is not statistically significant. This equally means that gender is not a significant factor in determining students' achievement in introduction to networking. The partial eta squared value of 0.014 shows that only 1.4% of students' achievement is accounted for by gender.

Research Question Three: What is the interaction effect of treatment and gender on the mean score of students in introduction to networking?

Table 3: Pretest and Posttest of the interaction effect of treatment and gender on the mean score of students in introduction to networking

SN	Treatment Groups	Gender	N	Pretest $\bar{X}$	SD	Posttest $\bar{X}$	SD	Mean Difference
1	MEPLN (Treatment Group)	Male	22	55.18	14.35	74.09	9.46	18.91
		Female	11	53.09	15.34	66.73	13.61	13.64
2	Lecture Method (Control Group)	Male	35	44.14	13.15	62.77	12.69	18.63
		Female	14	48.64	12.11	64.57	11.06	15.93

The results in Table show the interaction effect of treatment and gender on students' achievement in introduction to networking. Results show that the male students in experimental group had mean difference of 18.91 while the female students had mean difference of 13.64, which implies that MEPLN favoured the male students more than the female students when taught introduction to networking. Also, the results show that the male students in the control group had mean difference of 18.63, while the female student had mean difference of 15.93, which clearly show that the male students also performed better than their female counterparts when taught using conventional lecture method of teaching. To test whether the interaction between treatment and gender on students' achievement in introduction to networking is statistically significant, see hypothesis three.

Ho3: There is no significant interaction effect of treatment and gender on the mean score of students in introduction to networking.

Table 6: Analysis of the Covariance (ANCOVA) of the interaction effect of treatment and gender on the mean score of students in introduction to networking

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2209.682[a]	4	552.420	4.089	0.005	0.175
Intercept	18162.666	1	18162.666	134.434	0.000	0.636
Pretest	404.538	1	404.538	2.994	0.088	0.037
Treatment	468.554	1	468.554	3.468	0.066	0.043
Gender	150.350	1	150.350	1.113	0.295	0.014
Treatment * Gender	271.524	1	271.524	2.010	0.160	0.025
Error	10403.062	77	135.105			
Total	376835.000	82				
Corrected Total	12612.744	81				

The result of the study as presented in Table 6 shows that the following results were obtained with regards to the interaction effect of treatment and gender on students' achievement in introduction to networking, $F (1, 77) = 2.010$, $p = 0.16$, $\eta^2_p = 0.025$). Since the p-value is greater than 0.05 set as level of significance for testing the hypothesis, this means that the result is not significant, and inference drawn is that the interaction effect of treatment and gender on mean achievement of students in introduction to networking is not statistically significant. This result is further explained using an interaction graph below which shows that there was no significant interaction effect of treatment and gender on students' achievement in introduction to networking. This is evidenced in the graph as the lines representing treatment and gender did not intercept at a point as shown in the graph below.
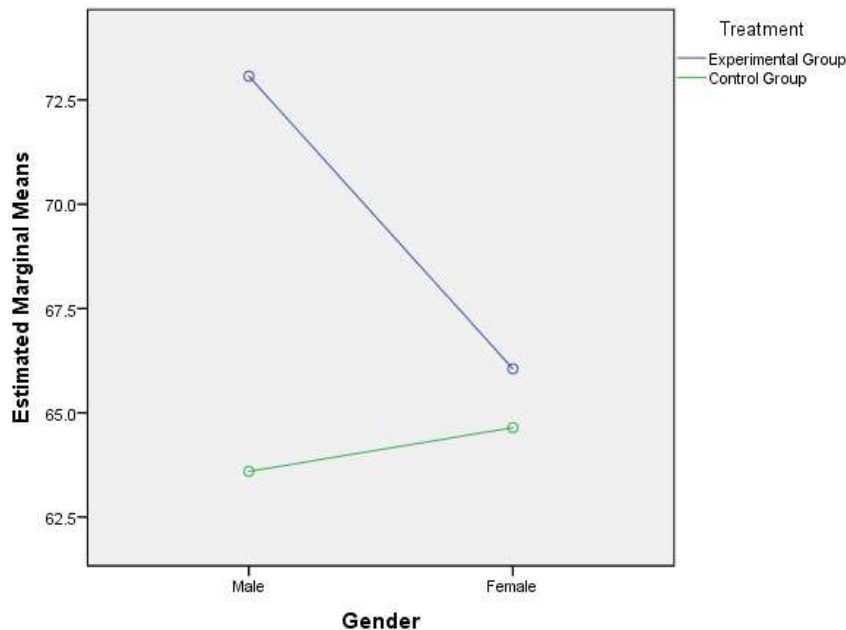

Fig. 1: Graph showing the interaction effect of treatment and gender on mean achievement scores of students in introduction to networking.

Discussion and Conclusion

The study showed that the students taught by the CLM improved better than those taught by MEPLN e-learning, whose mean score improved. The study produced an unusual result that has been encountered only once in the related empirical literature, where the new method is generally reported to be significantly better than the traditional methods. However, there were many adverse circumstances beyond researchers' control that probably intervened during the study.

One of the adverse circumstances was the over week power failure at the treatment location soon after the study began. It may have made charging handsets difficult for the treatment groups thus, denying them full access to the study materials and reducing their enthusiasm. Another may be the prevalence of intractable security challenges in the treatment location. Some parents may not be keen on getting ICT gadgets for their wards, as these sometimes serve to attract the attention of criminals. Furthermore, e-learning requires training of teachers for requsite skills and competencies. This was not done for the study. The result of the study may therefore be considered inconclusive till further study determines the interactive effects of these other extant variables.

Recommendations

1. All efforts should be made to achieve steady power supply in the country. So many vital things depend on it.
2. Where national power supply fails, institutions should make efforts to meet their power need by harnessing solar energy.
3. Teachers should be trained in e-learning. The required skills and competencies should be clearly identified through quality research, and intensive training programs embarked upon to prepare Teachers for this globally inevitable stage of education. This should be the combined concern of governments at all levels, industries, non-governmental organizations, and the Education Faculties in all Universities in the country.

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