



Comparing the Effectiveness and Student Academic Performance for Face-to-Face Classroom Learning and Online Learning in Calculus Course

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ABSTRACT:

One of the critical challenges in the education system occurred globally at the end of 2019. The outbreak of the COVID-19 pandemic certainly affected all aspects of life in the world. Nigeria is no exception affected by the pandemic. One of the things that is affected is education system. Unusual learning systems for some students certainly affect the effectiveness of the teaching and learning process. This study compared the academics performance of experimental and control group students for National Diploma II (ND II) enrolled in calculus course for the department of Computer Science, Electrical and electronic engineering and Science Laboratory Technology at Kebbi State Polytechnic, Dakingari. The population of the study comprised of ninety (90) students, forty (40) students participated as experimental group while remaining fifty (50) students as control group. Data were collected using 20 items essay test questions with reliability coefficients of 0.76 and analysed with SPSS-V21 using independent sample t-test after eight (16) weeks of continuous treatment. The study were guided by one (1) research question and one (1) null research hypotheses (Ho) at significance alpha value of 0.05. The groups were exposed to pre-test before the actual commencements of the treatments. The result of the post-test revealed that, there is significant difference between the experimental and control group students' performance that learned calculus course with $t(88) = 5.861$, $p\text{-val} = 0.000$, $df = 88$, mean difference = 13.235 and 95% Confidence Interval (CI) = [8.74757, 17.72243]. The mean and standard deviation score for control group were (M = 66.560, Std = 11.996) and experimental group (M = 53.325, Std = 8.651). Equal variances was assumed from the levene's test for equality of variances. The researchers draw the conclusion that there is significant difference between the two groups of students who learned calculus course using e-learning and traditional method classroom in the kebbi state polytechnic Dakingari.

Keywords: Calculus course, e-learning, Classroom, effectiveness, Students, Academic performance.

INTRODUCTION

One of the critical challenges in the education system occurred globally at the end of 2019. The outbreak of the COVID-19 pandemic certainly affected all aspects of life in the world. Nigeria is no exception affected by the pandemic. One of the things that is affected is education system. Since March 2020 most tertiary institutions have implemented rules of online learning without face to face in order to minimize the spread of the Covid-19 virus. Unusual learning systems for some students certainly affect the effectiveness of the teaching and learning process.

The education system posed at schools and universities; all educational institutes initially posed a short-term closure; however, WHO (World Health Organization) warned of the danger of the pandemic and decided to announce the entire shutdown. Therefore, technological tools such as laptops, iPods, smartphones and the Internet became the core of education. Colleges, Schools, universities and institutes started using Learning Management Systems as online platforms for teaching and learning. Overall, e-learning replaced face-to-face learning. The new learning environment changed teachers' and learners' styles, behaviours, teaching procedures, testing methods, etc. [1].

The history of online learning is particularly interesting because it not only shows the contributions of individuals but also institutions to the advancement of education and the sharing of that knowledge and skills on a global scale. As we briefly review the historical development of this subject, it is important to indicate that many authors use the terms "distance learning," "distance education," "online learning," "online education" and "e-learning" interchangeably,[2] as is the case in this study.

Prior to COVID-19, we can find no record of Calculus course or any higher-level math course being offered online at our institution. However, the transition to online learning in the first semester 2022/2023 academic session forced instructors to adapt all math courses to an online environment extemporaneously. Further, it meant that math courses would be offered fully online for the foreseeable future beginning first semester 2022. Leaning on the social presence literature for guidance, my experience teaching Calculus course fully online helped me understand the potential for creating a strong and effective online learning experiences in advanced mathematics courses.

Teaching and learning processes are rapidly becoming technology-driven, with the integration of digital learning using online learning platforms to facilitate instructional delivery. The google classroom learning platform is one of the most effective ways to improve student engagement in an online learning environment (Noah & Gbemisola, 2020) [3]. This study investigated the effectiveness and Student Academic Performance of Face-to-Face Classroom Learning and Online Learning in Calculus Course in Kebbi state polytechnic Dakingari.

REVIEW OF LITERATURE

Education is among the sectors with devastating impact of COVID-19 pandemic. Before the pandemic, the Nigerian education system has adopted purely, face-to-face approached to teaching and learning in primary and secondary schools. Primary and secondary school learners were not allowed to own any digital gadget such as phone or computer, neither were they allowed to be seen with such in the schools. With the emergence of the lockdown condition and school closure, following the COVID-19 pandemic, both teachers and learners were helpless about how to continue learning in the face of the pandemic [4].

The Covid-19 pandemic posed an abrupt change in the global education system at the end of 2019. Then there was a shift from the traditional face-to-face learning style to electronic educational learning styles through computers, smartphones, and the Internet. The situation highlighted the role of face-to-face and E-learning methods among researchers, teachers, and instructors. One important raised question delved into the difference between the two methods. To discuss the difference between face-to-face and E-learning styles, first, a brief description of each is presented here respectively. Face-to-face learning has been recognized as a historical teaching procedure in the classroom. [5] believed face-to-face learning is a “Traditional classroom environment where the instructor and the students are not separated by geographic space or time.” Also, it was stated that the traditional classroom or face-to-face instruction is when the instructor and the students of a non-profit educational institution are in a place devoted to education, and the teaching and learning take place at the same time. In this setting, all performances and displays of a work are allowed [6]. [7] Believed that the environment in which teaching and learning occur is as important and influential as other factors such as learning techniques, approaches, learners’ styles, and individual differences. Therefore, they compared face-to-face and online learning in English grammar learning. A recent approach replaced by face-to-face learning is E-learning. It has been stated that E-learning is a whole concept that began to emerge in the late 1990s [8]. It was due to technological advancements that created changes in learning systems. E-learning includes broad-ranging tools such as interactive television, smartphones, smart boards, the internet, wikis, etc. These educational advancements have blended with face-to-face learning or specific universities and institutes until the pandemic in 2019. The sudden widespread of Covid-19 made the entire world education system shift to E-learning in all grades, from elementary to universities. Now e-learning is the only medium of teaching that has brought about many challenges and efforts for all its users worldwide.

The study that investigated the impact of implementing integral calculus lectures which were originally very suitable in the face-to-face delivery, but during the Covid-19 pandemic situation, these were delivered online through e-learning was presented by [9]. The different categories of e-learning that includes informal and blending learning, network and work-based learning. The research that examines the use of Virtual Learning Objects (VLO) in the teaching of differential calculus in the area of Management Sciences as a teaching strategy to improve the assimilation of the theoretical knowledge acquired in the classroom courses discussed in [10]. The effectiveness of online learning in calculus 2 during the Covid-19 pandemic. The study was conducted in a civil engineering study program at a private tertiary institution on Sumbawa Island. The research is a quasi-experimental research design model non-equivalent control group design was presented by [11].

RESEARCH QUESTION

This study scrutinized the following question:

Do the two methods of face-to-face (class room) and E-learning education have a different effect on the Student Academic Performance Learning Calculus Course at kebbi state polytechnic Dakingari?

RESEARCH METHODOLOGY

Research Design

This study used a quasi-experimental approach to answer research question (RQ) by using experimental and control group. The experimental group were taught the Calculus courses using E-learning calculus tutoring system while control group taught the same using face-to-face method. Before the actual commencements of the treatments a pre-test was conducted to both groups in order to assess their level of basic calculus. An e-learning calculus tutoring system were used for the online lectures delivery and a system (website) was developed and hosted online to view the uploaded instructional videos from the YouTube. Sixteen (16) weeks of continuous treatment was conducted, at the end the two groups undergo a post-test. Collected data were analysed using mean, standard deviation and t-test statistics to find significance differences in academic performance between the groups.

Participants and Sampling

In this study, National Diploma II (ND II) students from three (3) Department were selected, the Department are: Computer Science, Electrical/Electronics Engineering, and Science Laboratory Technology (SLT) studying at the Kebbi state polytechnic Dakingari to learn calculus Online and face- to-face

Class room. The population of the study comprised forty (40) students participated as experimental group and fifty (50) students as control group in all the three (3) departments. Therefore, a total of ninety (90) students participated in the study.

Test Instruments

In this study, student performance is going to be operationalize by final course grades. The final course grade was derived from test, Assignment and class participation scores. The three (3) aforementioned assessments were valid and relevant; they were useful in gauging student ability and generating objective performance measurements.

Data Analysis

The analytical instrument used was the Statistical Package for Social Sciences (SPSS). The respondent demographic data were analyzed using percentages and frequencies. Additionally, we assessed the measurement items' internal consistency using the Cronbach alpha. The correlation coefficients between the constructs were also examined. We employed the independent samples t-test to find the differences in learning effectiveness and students' academic performances to address the research questions.

Data Collection Procedure

The study and data collection were in the academic year (2022/2023). Participants were National Diploma students taking the Calculus course as one of their units. Polytechnic classes last for 16 weeks. The two groups were taught differently. In face-to-face learning, students participated in regular classrooms at the polytechnic. They received traditional in-person teaching methods. The instructor lectured and presented the materials. Students completed exercises and participated in group activities. In the e-learning group, participants were taught using an e-learning calculus tutoring system provided by the researchers. The online platform on which classes were held was E-learning calculus system. In the first session, the instructor introduced the materials that were supposed to be implemented during the term. Also, the instructor presented guidelines for students on how to connect during e-learning sessions. At the end of the treatments, the test was conducted as an instrument to collect data for the study. A ten (10) items essay test questions which has a reliability coefficients of 0.76, indicating that it was reliable to assess the academic performance of the experimental and control groups. The students from both groups were expected to score a maximum of hundred (100) marks.

Research Hypotheses

Ho: There is no significant difference in the performance of experimental group taught calculus course using e-learning calculus tutoring system and control group taught using face-to-face classroom (traditional) approach. The hypotheses were tested at .05 level of significance difference.

DATA ANALYSIS, RESULT AND DISCUSSIONS

An investigation was carried out to divulge the significance difference between experimental and control group students that learned Calculus course using e-learning for the experimental group and classroom (conventional) lectures for the control group. The post-test to both groups was performed one (1) week after the sixteen (16) weeks of continuous treatment. Therefore, independent sample t-test was performed to compare the mean, standard deviation and the calculated p-values were compared with the alpha value of 0.05 as specified in the study. Table 1, presented the result of the two (2) groups of students.

Table 1: Post-test result on Calculus course

Test	Group	Class size	Mean	Std.	df	MD	t-test-val	p-value
CALCULUS_Post_Test	EG_E-LEARNING	40	53.325	8.651	88	13.235	5.861	0.000
	CG_CLASSROOM	50	66.560	11.996				

NOTE: EG = Experimental Group; CG = Control Group; Std. = Standard Deviation; df = Degree of Freedom; MD = Mean Difference; t-test-val = T test value; P-val = Probability Value.

An independent sample t-test was conducted to compare the effectiveness and student academic performance for face-to-face (classroom) learning and online learning in Calculus course. The result in table 1 showed that p-val is 0.000 which is less than our chosen significance alpha value of 0.05 ($0.000 < 0.05$), this indicate that there is significant differences between the two groups ($t(88) = 5.861$, $p\text{-val} = 0.000$, $df = 88$, mean difference = 13.235 and 95% Confidence Interval (CI) = [8.74757, 17.72243]. The mean and standard deviation score for the Face-to-face (classroom) students (control group $M = 66.560$, $Std = 11.996$) Therefore, students that learned calculus course using Face-to-face (classroom) that is control group scored is significantly higher than students in the experimental group whose learned the course using e-learning with ($M = 53.325$, $Std = 8.651$). Equal variances was assumed from the levene's test for equality of variances. Therefore, since the p-val 0.000 is less than the alpha value of 0.05 ($p\text{-val} = 0.000 < \alpha\text{ value} = 0.05$). Hence, the null hypotheses (H_0) was rejected and we draw the conclusion that there is significant difference between the two groups of students whose learned calculus course using e-learning and traditional method classroom in the kebbi state polytechnic Dakingari.

The research question investigated if the two methods of face-to-face and e-learning education have a different effect on the Student Academic Performance Learning Calculus Course at Kebbi State Polytechnic Dakingari. It was found that students in the face-to-face group outperformed the e-learning group. In other words, students' scores were higher in the face-to-face group than in the e-learning group. A face-to-face classroom is an instructional approach presented to a group of learners in a classroom environment at a set time. Students are more familiar with face-to-face learning than e-learning. Average student learning outcomes are decreased when the online learning system is influenced by many factors.

One problem is the location of lecturers and students who are not in the same location. This of course makes the focus of the students can be divided differently from conventional learning systems that are face to face. This study's findings agree with research conducted by Firman and Rahman [12] which concluded that one of the difficulties of the location of lecturers and students who were separated when carrying out learning made the lecturer unable to directly monitor student activities during the lecture process. There is no guarantee that students really pay attention to the explanation given by the lecturer. Szpunar, Moulton, & Schacter [13] stated that students fantasize more frequently in online lectures compared to face-to-face lectures. Therefore, Khan [14] suggested that online lectures should be carried out in a short time because of difficulties in maintaining concentration if online lectures are held for more than one hour.

Another factor influencing the ineffectiveness of the online learning process in this study is supporting facilities. Supporting facilities in this case the internet connection. Most students in this study use cellular data to connect to the internet. The data package used during the online learning process is certainly not small. Plus the location of students who are indeed difficult to reach by internet connections. In line with research conducted by Kuo et al. [15] which states that online learning is more student centered so that it can bring up the responsibility and autonomy of students in learning. Online learning requires students to prepare their own learning, organize and evaluate and simultaneously maintain their learning motivation [16].

Another difficulty that makes the online learning process ineffective is the difficulty of understanding the material provided online. Students still need verbal explanations by the lecturer for some material that is considered complex and not enough to be solved by instant messaging applications or discussion columns that exist in online class applications. Online learning requires students to be more independent and disciplined in understanding each given material.

CONCLUSION

Based on the research process that has been carried out it can be concluded that the online learning process in the calculus course has not been effective. Some factors that are the cause of the ineffectiveness of online learning in this research are internet connection and the lack of understanding of students in this online learning process. The independence and discipline of students need to be improved in improving the effectiveness of online learning. In addition, facilities and infrastructure as well as learning media must be more interesting and effective. Some of these things can be considered considering online learning will be a must in the era of technological advancements.

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