



Effect of Virtual Learning on Students' Academic Performance in Mathematics in Post Covid-19 Era

Ayeni, Adeniyi A. ^a & Aderinkola, David A. ^b

^aDepartment of Mathematics Federal College of Education (Special), Oyo, Nigeria

^bFederal College of Education Special Oyo in affiliation with University of Ibadan, Ibadan, Nigeria.

Corresponding author: davidaderinkola001@gmail.com

Abstract

Virtual learning has resulted in the development of new instructional techniques. This study looked at the effect of virtual learning on students' academic performance in mathematics in post Covid-19 era. This study encompasses a quasi-experimental design with nonequivalent control group using pre-tests and post-tests. The sample is made up of 100 students chosen at random from five secondary schools in Oyo State. The experimental group studied academic subjects using virtual learning while the control group studied in an exceeding classroom with a tutor who explained mathematics (i.e. conventional method). Personal data of respondents were examined using frequency count & percentage while MTI collected were analyzed using mean, variance and independent ANCOVA to answer the two research hypotheses at 0.05 (5%) significant level. The findings show that among others that virtual learning has positive impacts on the students, online education provides a chance for self-study. Thus, the researchers recommended that the virtual learning should be available and utilized for optimum learning.

Keywords: Virtual learning, Mathematics, Students' academic performance.

Introduction

Educational institutions around the world have suspended face-to-face lessons and switched to virtual learning due to the new coronavirus pandemic. Coronavirus disease 2019 (COVID-19) was originated from Wuhan city in China in December 2019 which spreads exponentially not only in China but also worldwide (Zhu N et al, 2019) therefore, the World Health Organization (WHO) has announced it as pandemic on March 12, 2020. Several government measures have been taken to address the risk of the spread of the disease. These measures include travel restrictions, forced quarantine of travelers, social distance, bans on public meetings, school and university closures, business closures, self-quarantine, requiring people to work from home, and a curfew.

Authorities in several countries around the world have declared either a blockade or a curfew as a means of curbing the rapid spread of viral infections. These measures are negatively impacting the world's economy, education, health and tourism. The COVID-19 pandemic has affected all levels of the education system. Educational institutions around the world (192 countries) are temporarily closing or implementing regional closures, affecting approximately 1.7 billion students worldwide (UNESCO, 2020). Many educational institutions around the world have postponed or canceled all school activities to minimize or reduce viral infections. For classroom interruptions at many universities, switching to virtual classrooms for students would be useful. Olabisi (2020) found that

universities around the world are using communication technology to mitigate the impact of a pandemic on semesters. Huili (2020) encourages most Chinese universities to adopt online education instead of face-to-face education as a result of the new coronavirus epidemic, which is likely to last indefinitely. In Australia, classes have switched online, similar to universities in the UK and Canada, which have phased out face-to-face classes. In Turkey and Kenya, universities have enabled communication between faculty and students via social media platforms and email, and classes in the Philippines and Kyrgyzstan are now completely online. French teachers are working on Zoom with their students (Olatunde-Aiyedun T. G. et al., 2021).

In Nigeria, as a precautionary measure to curb the spread of coronavirus disease (Covid-19) in the country, the Federal Ministry of Education ordered the immediate closure of all educational institutions, including universities, junior high schools and primary schools across the country in 2020. To curb the spread of the virus in Nigeria, the Federal Ministry of Education has ordered all institutions in Nigeria to shut down and send students home (Ogunode 2020a; Jegede, 2020; Ogunode, Abigeal & Lydia, 2020). As a result, Nigeria is one of the growing countries in Africa and a world where schools and universities are blocked. However, the school was officially reopened around September/October in 2020 with an emphasis on online education to curb the spread of the Covid-19 virus. Despite the uncertainties of the post-Covid-19 era,

digital students are eager to access online learning opportunities (Olatunde-Aiyedun, Eyiolorunse-Aiyedun&Ogunode, 2021).

Virtual learning is an online learning environment (Wang &Newlin 2012). The characteristic of online courses is a type of distance learning. The form of delivery goes by many names: e-learning, Internet-based learning, distributed learning, distance learning, virtual classroom or web-based learning (WCET, 2004). Online synchronous learning is, in many ways, similar to a physical classroom. For example, physical and virtual classrooms allow for immediate feedback, interaction with instructors and peers, and guided exercises to motivate and enhance student learning. Collis (1996) described four equally compelling advantages of synchronous systems in the educational context. Virtual learning has been described by Turoff (2007) as a web-based environment that allows an individual to participate in live training events without having to travel elsewhere. You can sit in the comfort of your surroundings and listen to lectures. You can engage in math exercises, ask questions, and effectively interact with your teacher as if the actions were happening in a regular classroom, but it's done with the convenience of public devices. technologies such as Internet-connected desktop computers and telephones. On the other hand, the Internet offers new advantages and ways to communicate, interact and evaluate information for teachers and students.

Writing about the definition of virtual learning, technopedia considers it "an online classroom environment facilitated by specialized video conferencing applications". In this environment, individuals will be able to interact with each other, communicate, view and discuss the course content presented through an internet connection while working as a team in the online environment to actualize learning. From the Whatis.com, a virtual classroom is "an online learning environment". It is like the real world of the classroom, where students participate in a virtual classroom in synchronous instruction. That is, teachers and students must be simultaneously connected to the virtual learning environment (VLE). Virtual Learning (Rachang, 2018) is an online learning environment that allows for face-to-face interaction between tutors and learners as they engage in learning activities. Some achievements from virtual learning are as follows; It gives learners the flexibility to get a learning experience when, where, and at an assimilated pace. Virtual learning can help with good classroom organization. Activity documents, assignments,

lectures and other relevant information on the Internet can be easily stored for easy access by teachers and students. Information posted on the Internet can be easily modified and updated to serve teaching and learning more effectively.

Virtual learning gives learners the opportunity to have a 24/7 learning experience without affecting learners' free time. The system is capable of utilizing the services of the most experienced staff in various fields of need, which is not possible in a traditional classroom. Another educational value is the intellectual and social partnership created by virtual classroom technology. Students in their use of technology cultivate the habit of taking a leadership role over other students. The implication is that the technology used increases group cohesion and mutual support, especially in remote classrooms. In addition, virtual learning allows students to develop a range of communication skills that help them perform well in the classroom. Virtual learning helps students save money, time and transportation. Motivated students can work alone in their home environment without wasting time and money on campus. Teachers also value teaching because everything is digital and these works are generally delivered via typed e-mail. Teachers can easily reuse their materials and can easily get them elsewhere. The system can prove very beneficial to students in various ways when it comes to its online features. It will help with admission, information about courses and learning activities, homework and projects, tests and assessments, grading and results, teachers available for interaction, advice and help needed, information about starting construction exams, achievement programs, entry to a specialist and professional streams, and more.

Academic performance refers to how students manage their learning and how they cope with or accomplish various tasks assigned by their teachers. Academic performance is the ability to study and remember facts and to be able to communicate facts and knowledge orally or on paper. Flegm (2005) reports that in educational institutions, success is measured by academic performance or the extent to which a student meets the standards set by the institution. In addition, there are inconclusive findings on individual factors that predict academic success, things like test anxiety, environment, motivation, and emotions that need to be considered when developing models of academic success. As reported by researchers such as Drennan and Rhode (2002), student achievement in mathematics is not impressive, and the reasons for this need to be investigated. Some of the factors that have influenced

academic achievement are; The influence of individual differences on academic performance is related to differences in intelligence and personality (Stumm, 2011). Students with higher mental ability as demonstrated by IQ tests and those who are higher in conscientiousness (linked to effort and achievement motivation) tend to achieve highly in academic settings. A recent meta-analysis suggested that mental curiosity (as measured by typical intellectual engagement) has an important influence on academic achievement in addition to intelligence and conscientiousness (Stumm, 2011).

This study adopted Bruner's constructivism learning theory which is a philosophy that enhances students' logical and conceptual growth. The underlying concept within the constructivism learning theory is the role which experiences-or connections with the adjoining atmosphere-play in student education. The theory argues that people produce knowledge and form meaning based upon their experiences i.e. knowledge is constructed through an individual's association with a given environment. Individuals in other words construct knowledge of their own when they are actively involved in learning by doing and sharing ideas with peers. In the process, the learner uses sensory knowledge in constructing meaning out of a given task. Two of the key concepts within the constructivism learning theory which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilating causes an individual to incorporate new experiences into the old experiences. This causes the individual to develop new outlooks, rethink what were once misunderstandings, and evaluate what is important, ultimately altering their perceptions. Accommodation, on the other hand, is reframing the world and new experiences into the mental capacity already present. Individuals conceive a particular fashion in which the world operates. When things do not operate within that context, they must accommodate and reframing the expectations with the outcomes.

The role of teachers is very important within the constructivism learning theory. In this theory, teachers function as facilitators rather than giving lecture whose role is to aid the student when it comes to their own understanding. The facilitator in this case must make it so that the student comes to the conclusions on their own instead of being told instead of answering questions that only align with their curriculum. Also, teachers are continually in conversation with the students, creating the learning

experience that is open to new directions depending upon the needs of the student as the learning progresses and make the students effective critical thinkers.

The Relationship Between Constructivism Learning Theory and Virtual Learning

The constructivism learning theory and virtual learning are relatively related in various forms as outlined below: (Chen, 2000).

1. Constructivist learning is always interesting, attractive, problem representing with contextual issues that surround the problem. However, virtual learning can present problem to students in a three dimensional environments that can portray the real world situation.
2. Constructive learning can give interpretations of a problem to encourage various ways of thinking. Nevertheless, virtual learning can present multiple viewpoints, independent controlled viewpoints for each learner and can do away with negative elements that would divert the attention of the learner in the learning process.
3. In constructive learning approach, the learner utilizes his sensory potentials to construct meaning out of a given concept. Although, the virtual learning creates problem space for free exploration. Here feedback and interaction can be observed through visual, auditory and other cues by participating learners.
4. Constructivist learning provides rich sources of information. Also, virtual learning contains required information and can be supported with other technological gadgets for more relevant information through the web.
5. In constructivist learning, conversation and collaboration tools are used to access and share information and knowledge to help learners construct socially shared knowledge. But in virtual learning, a shared space for a group of learners could be provided to collaboratively construct knowledge through synchronous and/or asynchronous communication. It could also take control of virtual bodies to actualize the reality of collaborative process.

Based on the purpose of the study, the following hypotheses were formulated to guide the study

H₀₁: There is no statistically significant difference in academic performance between Mathematics students exposed to virtual

learning and those exposed to conventional methods.

H₀₂: There is no significant difference between academic performance of male and female Mathematics students exposed to virtual learning.

Method

The study adopted pre-tests and post-tests of quasi-experimental design with a non-equivalent control group. This design was adopted because the experiment was carried out in intact classes (Ali, 1996). Intact classes were used to avoid disruption of normal classes. The design was necessary because it enhances intact class selection of participants for experimental and control groups. This study's population consisted of all Senior Secondary School (SSS) students in Oyo State, Nigeria. The sample is made up of 100 students chosen at random from five secondary schools in Oyo State. For the experimental (treatment) group 25 males and 25 females a total of 50 students were used for the study. On the other hand, for the control group, 25 males and 25 females were used for the study. For each school sampled, two intact classes were randomly assigned experimental and control groups. The experimental group studied Mathematics through virtual learning (making use of Telegram group and YouTube), whereas the control group learned through traditional methods of instruction that rely on conventional classes. The participants ranged in age from 14 to 19 years.

The researchers used a Mathematics Test Instrument (MTI) to collect data for the study while carrying out the investigation. The (MTI) included 20 multiple-choice items with four (4) option. The items were selected from the content which included algebra, trigonometry, statistics and probability. The questionnaire was reviewed by a Mathematics teacher and expert in the department of Educational

Technology and the Measurement and Evaluation section at the Federal College of Education Special, Oyo. Their suggestions were incorporated into the final version of the device utilized for data collecting. As a result, it was typed and given to the respondents. A test retest procedure was used on 50 secondary school students who were not involved in the reliability test process. Pearson Product Correlation Coefficient statistics were applied to their scores, yielding a reliability coefficient of 0.87. The instrument was deemed trustworthy for use in the study. The MTI was administered to respondents in both groups (experimental and control) by research assistants at their respective schools. The data was examined using descriptive statistics such as frequency counts, simple percentages, and ANCOVA (Analysis of Covariance) to assess the two hypotheses on student performance at the 0.05 significant level using pre-test as covariate.

Result

Table 1: The Mean score and Variance in Mathematics Test Instrument (MTI) of Experimental and Control group

Group	N	Pre-test MTI Mean	of SD	Post-test MTI Mean	of SD
Experimental Group	50	8.76	1.70	14.24	2.26
Control Group	50	8.81	1.98	9.36	2.02

Table 1 revealed that in pre-test, the mean score of control group is 8.81 with standard deviation 1.98 while that of experimental group is 8.76 with standard deviation 1.70. In post MTI, the mean score of control group is 9.36 with standard deviation 2.02 while that of experimental group is 14.24 with standard deviation 2.26 indicating that experimental group performed better than the control group.

Table 2: Analysis of Covariance (ANCOVA) of Students Scores in Mathematics Test Instrument (MTI)

Source of Variation	Sum of Squares	DF	Mean of Square	F	Sign of F	Decision
Corrected Model	596.465	2	298.232	64.352	.000	S
Intercept	589.750	1	589.750	127.255	.000	S
Pre-test	1.105	1	1.105	0.238	.626	NS
Group	586.333	1	586.333	126.518	.000	S
Error	449.535	97	4.634			
Total	1046.000	99				

S = Significant at .05 level. NS = Not Significant at .05 level.

The results in table 2 indicated that virtual learning as a corrected model on students' performance in Mathematics is significant $F(1, 97) = 3.94, p < .05$. Thus, the null hypothesis of no statistically significant difference in academic performance between Mathematics students exposed to virtual learning and those exposed to conventional methods is rejected at .05 level of significance.

Table 3: The Mean score and Variance in Mathematics Test Instrument (MTI) of male and female students exposed to virtual learning

Group	Type of Test	Male		Female	
		Mean	SD	Mean	SD
Exp.	Pre-test of MTI	9.72	1.10	8.56	1.96
Group	Post-test of MTI	15.12	1.88	12.40	2.06

Table 3 revealed that in pre-test, the mean score of male is 9.72 with standard deviation 1.10 while that of the female is 8.56 with standard deviation 1.96. In post MTI, the mean score of male is 15.12 with standard deviation 1.88 while that of female is 12.40 with standard deviation 2.06 indicating that male outperformed the female counterpart after being exposed to virtual learning.

Table 4: Analysis of Covariance (ANCOVA) of Treatment Male and Female Scores in Mathematics Test Instrument (MTI)

Source of Variation	Sum of Squares	DF	Mean of Square	F	Sig of F	Decision
Corrected Model	100.769	2	50.385	13.278	.000	S
Intercept	150.704	1	150.704	39.714	.000	S
Pre-test	8.289	1	8.289	2.184	.146	NS
Group	67.836	1	67.836	17.876	.000	S
Error	178.351	47	3.795			
Total	279.120	49				

S = Significant at .05 level. NS = Not Significant at .05 level.

The results in table 4 indicated that gender as main effect on students' performance in Mathematics is significant, $F(1, 47) = 4.05, p < .05$. Thus, the null hypothesis of no significant difference between academic performance of male and female Mathematics students exposed to virtual learning is rejected at .05 level of significance.

Discussion

The findings of the hypothesis one revealed that there is statistically significant difference in academic performance between Mathematics students exposed to virtual learning and those exposed to conventional methods. It can be seen that in post MTI, the mean score of experimental (treatment) group (14.24) is higher than their control group (9.36) counterpart as shown in table 1 symbolizing experimental group performed better than the control group. The result in table 2 further confirmed this by indicating statistically significant effect of virtual learning on students' academic

performance in Mathematics. It may well be deduced from the findings of this study that the employment of virtual learning in teaching and learning of Mathematics is more positive in enhancing and facilitating students' performance in Mathematics than the conventional method. This finding is in agreement thereupon of Perumalla et al. (2011) who opined that use of virtual classroom ensures effectiveness of instruction that enhance students' performance. The study is additionally supported by the work of Garrison and Cleveland-Innes (2005) who opined that online learning has great effects on students' learning, although they concluded that online learning interaction needed to be structured, planned and sustained. Gedera (2014) and Mallareddy (2015) who showed that use of virtual classroom developed better understanding of scholars experiences during learning, and also it removes barriers of your time and space, overcome the unavailability of teachers, sessions and might be quick to arrange.

The results of hypothesis two showed that there is significant difference between academic performance of male and female Mathematics students exposed to virtual learning. The result presented revealed that in the treatment group, the male students had higher mean score of 15.12 than their female counterparts mean score 12.40 as shown in table 3. By implications, male students outperformed female in Mathematics when exposed to virtual learning. This was further confirmed by the result in table 4 where gender had significant effect on students' performance in Mathematics. This can be in line with (Etukakpan. 2021) who reported that male students exposed to virtual classroom performed better than their female counterpart, though not significant. Research result show that there are gender inequalities in mathematics achievements in secondary schools. However, research evidence abounds to point out that girls don't seem to be achieving well of course in mathematics. Turton (2001) found that female students achieve under the males in mathematics. Female students should show more interest in virtual learning.

Conclusion

Based on this finding, the researchers observed that the employment of virtual learning is simpler at improving students' academic performance in Mathematics compared to the conventional method. This is often evident within the higher mean performance scores obtained by students who were exposed thereto. The students within the experimental group showed that they were curious about the virtual classes because it's interactive. The study concluded that the Mathematics students exposed to virtual learning i.e. experimental group performed far better than those students not exposed to virtual learning i.e. control group. The results of the two groups on the pre-test revealed that they were nearly equivalent. Virtual learning has the potential of improving their interest and performance in mathematics and help to stay the scholars up and running with a chance for self-study.

Recommendations

The researchers made the following recommendations based on the main findings of their study.

1. School administrators, teachers, students, parents, government organizations, the ministry of education, and curriculum planners are advised to adopt the innovation of virtual

learning in order to enhance the teaching-learning process.

2. Virtual learning makes it feasible to have educational resources in the classroom that would not otherwise be available. It eliminates the barrier of distance in education acquisition and expands learning. So, virtual learning should be available and utilized for optimum learning.
3. To facilitate easy access and communication with virtual classrooms, the government and educational institutions should provide free Wi-Fi or data subscriptions, technological devices, and assure continuous power generation.
4. For easy access to education and learning capacities, organized bodies and institutions should train teachers and students on the creation and usage of virtual classrooms.

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