# Virtual Learning and Undergraduate Students' Academic Achievement in Mathematics During Covid-19 Lockdown in Ibadan, Oyo State

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**Abstract:** This paper investigated Virtual Learning and Undergraduate Students' Academic Achievement in Mathematics during Covid-19 Lockdown in Ibadan, Oyo State. The study adopted One-group pretest-posttest Quasi-Experimental design. The population for this study was two hundred and eighty (280) First-year students in the faculty of Basic Medical and Applied Science, Lead City University, Ibadan, Nigeria. Sample for the study comprised Fifty (50) students who participated in the virtual learning in Applied Mathematics coded MTH 112 during COVID-19 Lockdown. The instrument for the study was Forty (40) objective questions optioned A to D on Applied Mathematics Achievement Test (AMAT). The instrument was validated and tested for reliability with reliability coefficients of 0.71. Student t-test statistics was used to test the Hypotheses generated at 0.05 level of significance. Hypothesis one revealed a significant difference in the achievement of students in Applied Mathematics when exposed to virtual learning, t-calculated (21.328) was greater than t-table (1.985). Hence hypothesis one was rejected. Hypothesis two also revealed a significant difference in the achievement of male and female students in Applied Mathematics in favour of male students, t-calculated (20.050) was higher than t-table (2.011). This infers that the male students achieved better than female students in AMAT when exposed to virtual learning. Hence, hypothesis two was also rejected. The study concluded that, Virtual learning encourages students' achievement in Applied Mathematics and recommended virtual learning to be adopted especially where physical classroom is constrained.

**Keywords:** Virtual Learning, Academic Achievement, Applied Mathematics, Undergraduates, COVID-19 Lockdown

## I. Introduction

One of the most important functions of an educational system is to produce the manpower which a nation needs to grow significantly and economically. The level of development of any nation has to do with the level of her technological advancement which hinges on Mathematics. In a developing country like Nigeria, emphasis on Mathematics cannot be overlooked for the purpose of technological developments. The knowledge of Mathematics is very crucial and important for a meaningful technological development in the society. The acquisition of such knowledge starts from the elementary schools through secondary schools and colleges up to institutions of higher learning. It is however important to note that Mathematics is vital for Nigeria to attain the level of self-reliance both technologically and economically due to its roles as a fundamental subject and basis for Science and Technology. In recognition of the importance of Mathematics, students' achievements in Mathematics at all levels of education must be a priority in order to uphold its importance in numeracy as it is being spelt out as one of the cardinal points of the National Policy on Education prepared by the Federal Republic of Nigeria (FRN, 2013).

An aspect of Mathematics that is relevant to everyone from a layman to artisans is a topic on vectors. Vectors are important aspect of Applied Mathematics, simply addressing Mathematical quantities with magnitudes and directions. Scalars on the other hand are quantities with magnitudes only. A quantity which is completely specified by a certain number associated with a suitable unit without any mention of direction in space is known as scalar. Examples of scalars are time, mass, length, volume, density, temperature, energy, distance, speed and other quantities which are measured without specified directions. The number describing the quantity of a particular scalar is known as its magnitude. Scalars quantities can be added, subtracted, multiplied and divided by the usual arithmetic operations. When vectors are added, a resultant vector is arrived at. This is possible because a quantity which is completely described when both the magnitude and direction are specified clearly indicated a vector quantity. Examples of vectors are: force, velocity, acceleration, displacement, torque, momentum, gravitational force, electric and magnetic entities etcetera. A vector can be represented by a Roman letter in bold face and its magnitude, by the same letter in italics. Vectors are important to drivers, pilots, and captains of ships to be able to navigate through to their destinations with defined directions from the starting points. In other words, everyone needs to know the direction he or she is heading to in order to get things done with ease (Spiegel, & Lipschutz, 2009).

The knowledge of vectors enables one to have an idea of one's target(s) as well as knowing how to work towards achieving such target(s). The study of vectors can best be understood when a straight line is drawn or sketched with labels and arrows to indicate which direction such a vector is pointing to, to gain clarity. In understanding the idea of vectors, the labeling and the arrows are read from left to right in anticlockwise directions except the resultant vector which closed up the vectors in a clockwise route. The knowledge of vectors encompasses what only the physicist and astronauts need but benefitted all in finding routes to destinations as well as the length of the distance and the time needed to get there (Stroud, 2006).

A way of measuring students' progress in schools is through their achievements in school subjects. This can be measured in many ways such as after each class activity, which could be done on weekly or monthly basis or at the end of a course/subject in form of examinations. Students' achievements can be motivated by using the right tools to teach the right topics or subjects. Most of the times, teachers' inability to apply the right method could affect students' achievements in school subjects. Mathematics can best be understood by both teachers and the students when every student is considered important and part of every teacher's success story. Virtual learning helps teachers to connect to both large classes and smaller classes and to individual student at any agreed time (Jean, 2021). Students who are naturally shy can easily link up with their teachers to be able to express their feelings and ask questions when the need arises. This is one of the ways that some educators imbibed during the COVID-19 Lockdown which was a period when the whole world was put on hold for months and people were restricted from exhibiting their social life styles.

The period of the Corona Virus Disease-19 lockdown tagged COVID-19 pandemic was discovered in Wuhan, China in December 2019 based on the reports of the United Nations (2020) and WHO (2020) which caught the world unaware. During COVID-19 lockdown, many students were unable to go to school nor receive any instruction pertaining to their studies as they usually practiced. Due to the lockdown, many businesses, firms and organizations were on hold, while some experienced lots of setbacks as a result of the stay-at-home policy to curb the spread of the pandemic. This global lockdown led to the closure of schools, colleges and universities at the end of February, 2020 while in some parts of the world the lockdown started in March, 2020. Businesses and offices were not left out of the lockdown experience due to the emergencies on health hazards caused by the pandemic. One major characteristics of COVID-19 lockdown was global restrictions on people's movements on the bases of the quarantine measures put in place to curtail the spread of the virus during physical contacts. In some instances, students could not get through to their teachers and lecturers neither were they able to get feedbacks from them as a result of the restrictions on physical interactions meted on everyone.

The situations during the lockdown deprived many students of social interactions with their school mates, neighbors and concerned people. School activities were hampered and parents were saddled with sudden responsibilities of tutoring their wards at home, especially the very young ones. Many families felt the hitch of the lockdown more than others due to their level of preparedness or the lack of it. Many institutions of learning also fell victims of inadequate preparations to thrive during the COVID-19 lockdown. These experiences caused by the pandemic resulted in the existing inequalities among students and institutions of higher learning with negative consequences on the intellectual and psychological well-beings of people from different parts of the world. However, many schools had difficulties on how to manage their students from their homes while the pandemic lasted (Spinelli, Lionetti, Pastore & Fasolo, 2020).

One of the measures adopted during the COVID-19 pandemic to mediate the effects of the lockdown was Virtual Learning. Virtual Learning is one of the methods in Information and Communication Technology (ICT) applied to education to enhance the delivery of knowledge, access to knowledge, and improves the quality of the education in the absence of a physical classroom. It involves the use of electronic gadgets, software and online Applications (Google classroom, Zoom, WhatsApp and others Apps) coupled with the internet connectivity to communicate with targeted persons or audience without any physical interaction. With virtual learning, online or electronic distance learning is made possible when the needed facilities are available. Virtual learning encourages the production of richer learning outcomes, enriched learning experiences as a result of critical thinking and offers a much broader spectrum of means for achieving educational goals (Bozkurt & Sharma, 2020). Virtual learning enhances teaching and learning through its dynamic interactive and engaging content and provides real opportunities for individualization of instruction. It also uses potentials to accelerate, enriches and deepens skills, motivate and engage students' learning. Virtual learning also helps to relate school experiences to work practices, creates economic viability for workers, in order to contribute to the total development of the institution, strengthens teaching and learning and provides opportunities for connections between the school and the world (Cellini, 2021, Enyedy, 2014).

Virtual learning facilitates school activities more in efficient and productive service deliveries through the organizations of varieties of tools to enhance teachers' professional activities. Virtual learning provides opportunities for schools to communicate with one another through e-mail, mailing lists, chat room, Google meet, zoom and other social media platforms. Quicker and easier access to more extensive and current information are being provided for through virtual learning. Adopting Virtual learning in schools enhances the capabilities needed for addressing challenges in delivery, management and support of effective teaching and learning. Virtual learning as an ICT tool enhances the needed change in modern day teaching and learning, all in a bid to create institutional

relevance via modern day technologies that are central to viable economic competitiveness. It is also a vital central force in economic and social shifts that is technologically skilled critically to accommodate the future employments of today's students (Daniel, 2020). Virtual learning can be used to teach students and pupils in various school subjects and at all times when the facilities are available and the teachers, coupled with their students are sensitized for such (Federal Ministry of Education, 2010).

Undergraduate students are students in higher institutions of learning which in this context is at the university level. It is the next levels of education ranked after secondary school depending on the mode of entry into the university. Students who have attended other institutions of higher learning such as colleges of technology, polytechnics and colleges of education also fall into this category in their various institution of higher learning. However, this study focused on the new intakes into 100 Level at the university who offered MTH 112 which is a course on applied mathematics that focused on vectors being taken by students at the preliminary level in the university. Many of this set of students are new and inexperienced in the university system. Some of them who had their secondary education as day students whereby they go to school every day from home were newly exposed to school life away from home for the first time and as a result, they need to be given the necessary supports to get stabilized with attending schools away from home. However, the Covid-19 lockdown has forced them back home without enough experience needed to cope at the university.

In order to manage this situation, virtual learning was introduced to bridge the gap created by the lockdown such that it was used as a mediator in form of drill and practices, whereby at the end of a lesson the learners can revise what had been taught in the virtual classes and ask questions in form of feedbacks where necessary, to be able to buttress understandings. With this mode of intervention, Learners can do self-assessment of themselves through various displays of sets of related questions on the computer devices after each lecture or lesson to check for understandings (Josiah & Etuk-Iren, 2014). A programmed answer corresponding to each question also beeps up to confirm the correctness of the answer proffered by each student on the subject matter. If the learner enters the correct answer the computer awards scores to each student at the end of the exercises through a display of total scores obtained against the obtainable scores or marks. This is followed by remarks such as''Good'', "Excellent" or''Try more'' after some trials.

Virtual Learning is one of the most frequently used tools in recent times especially when the teaching and learning activities are not within reach physically. Classrooms have changed dramatically over the last decades with the advent of new technologies and equipment that were developed to make teaching and learning more diversified and interactive. Students may no longer have to crowd around a computer monitor to view presentations, or training programs but privileged to learn and interact with teachers and colleagues based on one-on-one format through a specified application used as medium of instructions electronically (Liu, He, Zhao & Hong, 2021). Examples of such media are Zoom Application, Google Meet, Webinar, Club House and WhatsApp group call. These and many other online fora were adopted during Covid-19 lockdown to manage teaching and learning when physical distancing was enforced by the global government to manage the pandemic that ravage the whole world without minding the intellectual needs and developments of school children and students in general. This study was framed out from the outcomes of the measures meted to undergraduate students during the lockdown and coined as Virtual Learning and Undergraduate Students' Academic Achievement in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

## II. Statement of the Problem

There has been an increase in awareness on managing teaching and learning when there were needs to maintain physical distances between the learners, the teachers and the venue where teaching activities take place. This generates a concern in the education sector on how to ensure that students learn optimally at various educational levels and achieve the expected academic excellence in their academic pursuit as and when due. A variety of factors and constrains are competing with teaching and learning at periods of eventualities. These includes lack of adequate resources available, skills needed and sensitizations on the appropriate facilities based on each learning needs, power supply and internet connectivity and other factors related to both teachers' and learners' preparedness and readiness to learn. Virtual Learning is a form of ICT device needed to savage the time and location constraints in teaching and learning especially when social distance is enforced and needed to be observed. It is against this background that this paper was penned down on Virtual Learning and Undergraduate Students' Academic Achievement in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

### Purpose of the Study

The main purpose of this paper is on Virtual Learning and Undergraduate Students' Academic Achievement in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

Specifically, the study examined:

i. the effect of virtual learning and undergraduate students' academic achievement in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

ii. the difference between the academic achievement of students before they were exposed to virtual learning and after they were exposed to virtual learning in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

iii. the difference between the academic achievement of male and female students who were exposed to virtual learning in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State.

**Research Questions**

The following research questions were posed to help achieve the purpose of the study.

1. What is the difference between the pretest and posttest achievement of undergraduate students taught Applied Mathematics using virtual Learning during Covid-19 Lockdown in Ibadan, Oyo State?

2. What is the difference between the achievement of males and females' students taught Applied Mathematics using virtual learning during Covid-19 Lockdown in Ibadan, Oyo State?

**Hypotheses**

The following hypotheses were formulated and tested at 0.05 level of significance:

**H0$_1$:** There is no significant difference in the pretest and posttest achievements of undergraduate students taught Applied Mathematics using virtual Learning during Covid-19 Lockdown during lockdown in Ibadan, Oyo State.

**H0$_2$:** There is no significant difference between the achievement of males and females' students taught Applied Mathematics using virtual learning during Covid-19 Lockdown in Ibadan, Oyo State.

## III. Methodology

This study adopted a One-group pretest-posttest Quasi-Experimental design. The method was adopted on the group of students under investigation during the lockdown in order to get the effect of the intervention introduced to them which in this regard was the virtual mode of teaching and learning in the absence of the physical classroom during the COVID-19 Lockdown. The period of THE COVID-19 Lockdown was characterized with physical distancing and zero gathering to check the spread of the prevailing corona virus pandemic. The population for this study was two hundred and eighty (280) First-year students in the faculty of Basic Medical and Applied Science, Lead City University, Ibadan, Nigeria. Sample for the study comprised Fifty (50) students who participated in the virtual learning of Applied Mathematics coded MTH 112 during COVID-19 Lockdown. The instrument for the study was Forty (40) objective questions optioned A to D on Applied Mathematics Achievement Test (AMAT). The instrument was validated and tested for reliability with reliability coefficients of 0.71. The group was pretested on questions raised from the contents of Applied Mathematics course before being exposed to virtual learning strategies (via Google Meet, Zoom and WhatsApp) to teach the same course during Covid-19 Lockdown in Ibadan, Oyo State, after which a posttest was conducted on them. Student t-test statistics was used to test the Hypotheses generated at 0.05 level of significance. AMAT was divided into two sections A and B. In Section A information on the students' personal data were asked, while section B comprised forty multiple-choice questions with options A to D. The students were requested to tick correct option from the listed alternatives A to D on each question. The responses were analyzed using frequency counts and percentages to answer the research questions while t-test was used to test the Hypotheses at 0.05 level of significance.

## IV. Results

The data collected were hereby summarized.

**Research Question 1**: What is the difference between the pretest and posttest achievement of undergraduate students taught Applied Mathematics using virtual Learning during Covid-19 Lockdown in Ibadan, Oyo State?

Table 1: Pre-test and Post-test mean scores of Experimental group

| Group | Number | Mean Scores | Mean Difference (Mean Gain Score) |
|---|---|---|---|
| Post-test | 50 | 13.080 | |
| | | | 6.505 |
| Pre-test | 50 | 6.575 | |

In answering Research Question 1, pretest mean score of the group and the posttest mean score of the group were compared in table 1. The posttest mean score was 13.080 while the pretest mean score was 6.575. In other words, the posttest had a mean gain of

6.505, which was the mean difference between the posttest and the pretest scores of the group. This indicated that the virtual learning mode of teaching and learning during Covid-19 lockdown had effect on the sampled students.

**Research Question 2:** What is the difference between the achievement of males and females' students taught Applied Mathematics using virtual learning during Covid-19 Lockdown in Ibadan, Oyo State?

Table 2: Post-test mean scores of Male and Female students in the Experimental group

| Group | Number | Mean Scores | Mean Difference (Mean Gain Score) |
|---|---|---|---|
| Male | 29 | 14.052 | |
| | | | 2.005 |
| Female | 21 | 12.047 | |

In table 2, the post-test mean scores of male and female students in the experimental group are 14.052 and 12.047 respectively in the outcome of the Applied Mathematics Achievement Test (AMAT). A mean gain score of 2.005 was obtained as the mean difference between the achievement of male and female students exposed to virtual learning during Covid-19 lockdown in favour of the male students.

**H0$_1$:** There is no significant difference in the pretest and posttest achievements of undergraduate students taught Applied Mathematics using virtual Learning during Covid-19 Lockdown during lockdown in Ibadan, Oyo State.

Table 3: A t-test Comparison of Pretest and Post-Test Mean Scores of Students

| Variable | N | df | Mean | SD | t-cal | t-crit | Remark |
|---|---|---|---|---|---|---|---|
| Posttest | 50 | | 13.080 | 1.678 | | | |
| | | 98 | | | 21.328 | 1.985 | Significant |
| Pretest | 50 | | 6.575 | 1.366 | | | |

Table 3 displayed the result of the pretest and the posttest scores of students on Virtual Learning of Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State. The posttest mean score of the group of students was 13.080 while their pretset mean score was 6.575. The analysis of the result of the calculated t-test value was 21.328 while the critical t-table value was 1.985 at 0.05 level of significance. Since the t-calculated is greater than the t-table, the null hypothesis was rejected. Hence, there is a significance difference in the pretest mean score of the students before their exposure to Applied Mathematics using Virtual Learning mode of teaching and learning and their posttest mean score after the students were taught Applied Mathematics using the Virtual Learning mode of teaching during Covid-19 Lockdown in Ibadan, Oyo State.

**H0$_2$:** There is no significant difference between the achievement of males and females' students taught Applied Mathematics using virtual learning during Covid-19 Lockdown in Ibadan, Oyo State.

Table 4: A t-test Comparison of Post-Test Mean Scores of Male and Female Students in the Group

| Variable | N | Df | Mean | SD | t-cal | t-cri | Remark |
|---|---|---|---|---|---|---|---|
| Male | 29 | | 14.052 | 1.234 | | | |
| | | 48 | | | 20.050 | 2.011 | Significant |
| Female | 21 | | 12.047 | 0.995 | | | |

The analysis of achievement of male and female students in the sampled group on Virtual Learning and Undergraduate Students' Academic Achievement in Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State. The male students had a mean score of 14.052 while the female students had a mean score of 12.047. The analysis of the result of the calculated t-test value is 20.050 while the critical t-table value is 2.011 at 0.05 level of significance, as displayed in table 4. Since the t-calculated is greater than the t-table (t-critical), the null hypothesis H0$_2$ was rejected. Hence, there is a significance difference in the mean score of the male students taught Applied Mathematics using Virtual Learning mode of teaching and the female students using Virtual Learning mode of teaching and learning during Covid-19 Lockdown in Ibadan, Oyo State.

## V. Discussion of Findings

The main focus of this study was on Virtual Learning and Undergraduate Students' Academic Achievement in Mathematics during Covid-19 Lockdown in Ibadan, Oyo State. The findings based on Hypothesis One ($H0_1$) indicated that the students that were taught Applied Mathematics using Virtual Learning mode of teaching during Covid-19 Lockdown in Ibadan, Oyo State performed better after their exposure to virtual mode of teaching and learning of Applied Mathematics MTH 112 than before their exposure to Virtual mode of teaching and learning of Applied Mathematics during Covid-19 Lockdown in Ibadan, Oyo State. This finding corroborated the findings of Bozkurt and Sharma (2020). This was also in line with Daniel (2020).

From the findings on Hypothesis Two ($H0_2$), it was observed that the average mean score of 14.052 of male students in the group was higher than the average mean score of 12.047 obtained for female students in the group. This indicated that male students achieved better than female students in Applied Mathematics when exposed to Virtual mode of learning during Covid-19 Lockdown in Ibadan, Oyo State. Hence, Hypothesis Two ($H0_2$) was also rejected. Findings from table 2 indicated that gender had an impact on exposure to Virtual Learning mode of teaching and learning of Applied Mathematics during Covid-19 Lockdown in Ibadan Oyo State. This might explain why there was a disparity in the test scores of the participants based on their gender. This finding also corroborated findings on gender of students' and their performance at school (Josiah & Etuk-Iren, 2014). The result however was not in line with Liu, He, Zhao and Hong (2021) who found no significant difference between male and female students taught using Self-Regulated Online Learning in the context of virtual learning. This indicated that studies on gender is not conclusive.

## VI. Conclusion

From the findings of this study, there was a significant effect of virtual learning on the academic achievement of undergraduate students in Applied Mathematics during Covid-19 Lockdown after being exposed to virtual learning mode of teaching and learning applied Mathematics. It was also discovered that there was gender influence on the students exposed to virtual learning mode of teaching and learning applied mathematics in favour of the male students during Covid-19 Lock down.

## VII. Recommendations

In the light of the findings of this study, the following recommendations are made:

i. institutions of learning should train and encourage their teachers or lecturers and their students to develop interest and to be able to operate and use virtual learning in case of constraints of having face to face classes;

ii. parents should endeavour to provide handsets, laptops and data for their wards to afford them the opportunity to participate in virtual learning activities when the need arises; and

iii. close attention should be paid to female students to ensure their gainful participation in virtual class activities to encourage their better achievements in Applied Mathematics.

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