UNIJERPS
Unizik Journal of Educational Research and Policy Studies VOL.22 (1);
July-December, 2026 https://unijerps.org
2023 Impact Factor: 6.834; 2022 *Impact Factor*: 5.156; *2021 Impact Factor: 5.641;*
2020 Impact Factor: 5.355. Indexing and Impact Factor URL: http://sjifactor.com/passport.php?id=21363

IMPACT OF VIRTUAL CLASSROOM STRATEGY ON PERFORMANCE IN MATHEMATICS AMONG NATIONAL TEACHERS' INSTITUTE STUDENTS, NORTH-WEST, NIGERIA

Dr. Abubakar Abdul-azeez[1] and Saifullahi Abdul'aziz[2]
[1]Department of Academic Services, National Teachers Institute, Kaduna, abuadoro@gmail.com, 08067428749
[2]Ministry of Education, Katsina, Katsina State; azizsaif@gmail.coim, 08033929121

ABSTRACT
The study investigated impact of virtual classroom strategy on performance in mathematics among National Teachers' Institute students (NTI), North-West, Nigeria. Two research questions and hypotheses were formulated to guide the study. Non-randomized pre-test, post-test control group, quasi-experimental design was used. A sample of seventy-five (75) out a total population of 187 students were selected using multistage cluster sampling techniques, from three intact arm of classes from three out of fourteen study centers in three out of seven states in the study area. Mathematics Performance Test (MPT) with a reliability coefficient r = 0 .85 was used for data collection. The data collected were analyzed using mean and standard deviation to address the two (2) research questions while ANCOVA statistical analysis was used in testing the two (2) formulated null hypotheses at α = 0.05 level of significance. Pre-test result revealed that both experimental and control groups did not differ significantly in terms of their performances. However, the post-test result revealed that experimental and control groups differ significantly in terms of their performances in favour of the experimental group. Also, the male and female students in the experimental group differs significantly in terms of their performances. This shows that the virtual classroom strategy is not gender-friendly and impact positively on students' performances in mathematics. Based on the findings of this study, it was recommended that: the NTI-BDP mathematics teachers (facilitators) should incorporate virtual classroom strategy in the teaching and learning of mathematics and that NTI should organize workshop to train its Course Facilitators on the use of virtual classroom strategy in the teaching of mathematics concepts.

Keywords*: Virtual Classroom Strategy, Performance, Mathematics, National Teaches' Institute.*

Introduction
Mathematics plays an indispensable role in the progress and technological advancement of any society. Its extensive applications across various disciplines, including the physical and biological sciences, engineering, social sciences, medicine, and pharmacy, serve as compelling evidence of its significance. In Nigeria, Mathematics is a mandatory subject in primary and secondary education, regardless of a student's chosen academic track be it Arts, Commerce, or Science. Attaining at least a passing grade in Mathematics is a prerequisite for admission to any tertiary institution in the country. Moreover, at the tertiary level, general mathematics is a compulsory course for first-year students in almost all science and

engineering programs. It serves as a foundational requirement for courses within faculties such as technology, physical sciences, agricultural science, environmental design and management, and education, including specialized fields like chemistry education, mathematics education, and physics education. This underscores the critical role Mathematics plays in advancing science and technology. Mathematics equips students with a powerful toolkit for comprehending and shaping the world around them, including skills in logical reasoning and problem-solving (Mbacho, 2018). Its principal branches encompass algebra, number theory, geometry, and arithmetic, each contributing to the continuous evolution of this diverse field. Unlike the limitations of the past, modern mathematics has expanded significantly, making substantial contributions to technological innovation. Consequently, it rightfully earns the title "Queen of Science." As students' progress to higher levels of education, they encounter more advanced mathematical branches such as Algebra, Trigonometry, and Analysis. Therefore, education in mathematics is indisputably essential for the technological development of any nation.

Virtual classroom strategy refers to online (e-learning) classroom learning, that is continuously evolving with advancements in online technology. Jegede (2020), emphasize that e-learning enables both educators and learners to have continuous access to course materials, share announcements, submit assignments, and receive feedback. These advances in e-learning have opened up new opportunities for distance education, particularly in institutions like those in developing countries, such as Nigeria. E-learning encompasses various electronic delivery methods, including web-based multimedia, interactive television, Virtual classroom, and video conferencing which holds promise as an instructional medium. Organizations use e-learning to train employees, while educational institutions harness technology and the Internet to enhance the quality of education (Jegede, 2020). This research adopted National Teachers' Institute Learning Management System (LMS) having customized features of Moodle application software as virtual classrooms model. It was used as strategy to pass mathematics instruction to students to determine if their motivation to study mathematics could be enhanced.

However, regarding the term 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. Kassaw and Demareva, (2023) point out that addressing negative factors like inadequate classroom environments, dysmenorrhea, and excessive social media usage can improve academic performance while promoting positive factors like healthy sleep habits, high exam scores, and substance abuse avoidance. 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. Generally, academic performance serves as a key indicator of educational achievement. Higher academic performance at the university level often leads to better employment opportunities and salaries. Previous academic performance, such as high school GPA, is often predictive of future academic success (Alstete & Beutell, 2019). Mathematics performance, in particular, is vital in Nigerian education, with compulsory exams like WAEC and UTME serving as gateways to tertiary institutions. However, little is known whether the use of virtual classrooms is effective in enhancing the academic motivation of students (boys and girls) toward teaching and learning mathematics. It was on this note that the study investigated impact of Virtual Classroom Strategy on Motivation in Mathematics among National Teachers' Institute Students, North-West, Nigeria.

Objectives of the Study

The main objective of the study was to examine whether Virtual classroom strategy would improve students' performance in learning mathematics concepts at NTI-BDP, North West, Nigeria. The specific objectives were to:

1. find out the impact of virtual classroom strategy on the motivation level of students in mathematics identify the impact of the virtual classroom strategy on the performance of students in Mathematics.
2. find out the impact of the virtual classroom strategy on the performance of male and female students in Mathematics

Research Questions

Based on the objectives of the study, the following research questions were raised to guide the study:

1. To what extent do the mean performance scores of students taught Mathematics using the virtual classroom strategy and those taught with conventional methods differ?
2. What is the difference in the mean performance scores between male and female students taught Mathematics using virtual classroom strategy?

Null Hypotheses

Based on the research questions the following null hypotheses were formulated and tested at $\alpha = 0.05$ level of significance.

Ho_1: There is no significant difference between the mean performance scores of students taught Mathematics using virtual classroom strategy and those taught using conventional method.

Ho_2: There is no significant difference between the mean performance scores of male and female students taught Mathematics using virtual classroom strategy.

Research Methodology

The study investigated the impact of virtual classroom strategy on performance of students in mathematics among National Institute Students. This study employed a non-randomized pre-test post-test control

group, quasi-experimental design. This is because random assignment of subjects to the experimental and control groups were not allowed for the study rather, intact classes were assigned to experimental and control groups. The selected sample (experimental and control group) undergoes a pre-test to evaluate their motivation level before treatment. The experimental group (EG) were taught mathematics (MAT 212: linear algebra) using virtual classroom strategy while the control group (CG) received instruction through conventional method. The performances of both the experimental and control groups were measured using the Mathematics Performance Test (MPT) after the treatment in post-test to determine the effect of the treatment applied.

The study focused on NTI-BDP enrolled students in 200 levels (2023) of MAT 212 (Linear Algebra II) course in North-West, Nigeria. There was a total of 187 students spread across fourteen (14) study centres, consisting of 139 males and 48 females. The choice to include 200-level students in this research is motivated by their greater stability in comparison to 100-level students who are newly admitted, and 300-level students who are currently preparing for their Teaching Practice (TP) exercise. Additionally, 200-level students have already covered some essential mathematics content, providing them with relevant background of the topics covered in the study.

The multistage cluster sampling technique was used in selecting the sample for the study. This involved randomly selected: three intact arm of classes from three out of fourteen study centers in three out of seven states in the North-West, Nigeria. The three selected intact arms of classes were assigned randomly into experimental and control groups. The one arm that made up the experimental sample (N=31) consist of 20 male and 11 female students while the two arms that made up the control sample (N=44) consist of 29 males and 15 female students. This give a total sample size (N=75) which is viable for this study in line with Sambo (2008) who recommended that sample size of minimum of 30 subjects is viable for experimental study of this nature.

Data collection was through the use of the instrument tagged Mathematics Performance Test (MPT) comprises Six (6) essay questions with only one section. Students are expected to provide answers to four (4) of these questions. For each correctly answered question, students earned 25 marks. The test questions were adapted from previous semesters past questions from the NTI-BDP 200 level second semester course 2021/2022 session adopted from past NTI semester examinations (2020), to measure their performances before and after the treatment. The instrument was given to two experts (lecturers) who are Ph.D. holders within the Department of Science Education and one associate professor from Department of Psychology and Counseling of Education, Faculty of Education, Ahmadu Bello University Zaria, Kaduna State. The initial draft of the test was five (5) essay questions but in the course of the validation process, the validators were advised to upgrade one

question into two questions which made the test six (6) questions. Final copy of the instrument was produced with strict adherence to the observation made by the experts. Mathematics Performance Test (MPT) was found to be reliable because the tests were administered to thirty (30) NTI BDP FCE (T) Gusau study centre, Zamfara state. The pilot study was conducted using test re-test approach with two (2) weeks interval. This is in line with Tukman's, (1975) recommendation. The duration of the test was 2 hours. The scores of the test were then correlated using Pearson Product Moment Correlation (PPMC) test statistics. The result shows a reliability coefficient of 0.72.

The Mathematics Performance Test (MPT) was administered to the experimental and the control groups before and after treatment. The subjects were instructed to read the instruction on the test and respond appropriately depending on what they feel about each question. After completion, the test were collected from the subjects. However, mean and standard deviation were used to analyze data to answer the research questions while the formulated null hypotheses were tested using ANCOVA at 0.05 level of significance.

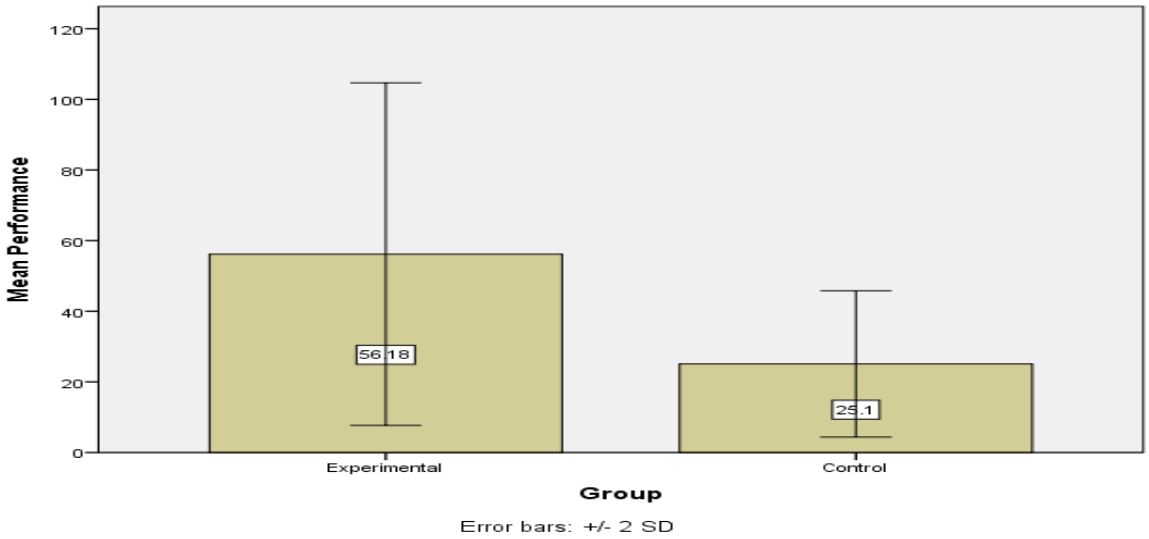
Presentation of Results

The results of the data analysis involved two sets of data, pre-experimental data (Pre-test scores) and post-experimental data (post-test scores). The data obtained from the administration of MPT during the pre and post-tests were analyzed by means of descriptive and inferential statistics to address the research questions and test the null hypotheses respectively using version 20 of the Statistical Packages for Social Sciences (SPSS) as follow:

Research Question 1: To what extent do the mean performance scores of students taught Mathematics using virtual classroom strategy and those taught with conventional methods differ?

To determine the extent to which the mean performance scores of students taught mathematics using the virtual classroom strategy differ from those taught using conventional methods, data were collected from two groups of students. The first group was taught using the virtual classroom strategy, while the second group was taught using conventional, face-to-face instructional methods. The students' performance was assessed through a standardized Mathematics Performance Test, and their scores were used to calculate descriptive statistics, such as the mean and standard deviation, for each group. The results of this analysis are shown in the figure 1, which presents the mean performance scores for both groups, accompanied by error bars indicating the standard error of the means.

Figure 1: Descriptive Statistics of Mean Motivation level of Experiment and Control



Groups Students

Figure 1 the mean and standard deviation in the performance of students in mathematics were compared between those taught mathematics using virtual classroom strategy and those taught using conventional method. The mean performance score for students taught using virtual classroom strategy was 56.18 with a standard deviation of 24.248. For students taught using conventional method, the mean was 25.1 with a standard deviation of 10.351. The mean difference in performance between the two methods was 31.08 in favor of the Virtual classroom strategy.

However, further analysis was conducted to ascertain whether the mean difference was statistically significant and this led to the testing of hypothesis three as presented in Table 1.

Ho_1: There is no significant difference between the mean performance scores of students taught mathematics using virtual classroom strategy and those taught using conventional method.

To assess whether there is a significant difference between the mean performance scores of students taught mathematics using the virtual classroom strategy and those taught using the conventional method, data were collected from two groups of students. The first group received instruction through the virtual classroom strategy, while the second group was taught using the conventional face-to-face method. Students' performance was evaluated using a standardized Mathematics Performance Test. To test hypothesis three that there is no significant difference between the mean performance scores of the two groups, an ANCOVA test was conducted. This test was chosen because it compares the means of two

independent groups to determine whether any statistically significant difference exists. The results are depicted in Table 1, which shows the mean performance scores for each group along with error bars representing the standard error of the means.

Table 1: ANCOVA Results of Significant Difference in the Mean Performance Score of Pre and Post-test Scores for Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Effect Size
Corrected Model	28883.370[a]	2	14441.685	46.849	.000	.441[a]
Intercept	25860.161	1	25860.161	83.891	.000	.413
Pre -test Performance	217.083	1	217.083	.704	.403	.006
Group	26890.997	1	26890.997	87.236	.000	.423
Error	36682.639	119	308.257			
Total	242571.000	122				
Corrected Total	65566.008	121				

a. R Squared = .441 (Adjusted R Squared = .431)

Table.1 presented the result of the Analysis of Covariance (ANCOVA) between the mean motivation level of students taught mathematics using virtual classroom strategy and those taught using conventional method. The result showed that F (1, 75) = 18.427, mean square of 1488.263 with an effect size of .136 and $p < .001$ was recorded. Since the p-value observed was less than $\alpha = 0.05$, the null hypothesis Ho_1 was rejected. This implied that there was significant difference between the mean motivation level of experimental and control group in favour of the former.

Research Question 2: What is the difference in the mean performance score between male and female students taught algebra using virtual classroom strategy?

To investigate the difference in the mean performance scores between male and female students taught algebra using the Virtual classroom strategy, data were collected from two subgroups: male and female students. Performance was measured using a standardized Mathematics Performance Test, which provided scores for each student. Descriptive statistics, including the mean and standard deviation of the test scores for both male and female students, were calculated to summarize the data. The results are displayed in the subsequent figure 2, which presents the mean performance scores for both male and female students, with error bars representing the standard error of the means.



Figure 2: Descriptive Statistics of Mean Performance Score of Male and Female Students in the Experimental Group

Figure 2 the mean and standard deviation of performance scores in mathematics between male and female students taught using a Virtual classroom strategy are presented. The mean performance score for male students was 65.18 with a standard deviation of 18.21, and for female students, it was 26.92 with a standard deviation of 17.49. The mean difference in performance scores between male and female students taught mathematics using a Virtual classroom strategy was 38.26 in favor of male students. This indicates that the mean performance scores for male students taught using the Virtual classroom strategy was higher than that of female students.

However, further analysis was conducted to ascertain whether the mean difference was statistically significance and this led to the testing of hypothesis six as presented in Table 2.

Ho_2: There is no significant difference between the mean performance scores of male and female students taught mathematics using the Virtual classroom strategy

To assess whether there is a significant difference between the mean performance scores of male and female students taught Mathematics using the Virtual classroom strategy, data were collected from both male and female students who participated in this instructional approach. Performance was evaluated using a standardized Mathematics Performance Test, and scores for each student were recorded. An ANCOVA test was used to compare the mean performance scores of the two gender groups. This test was appropriate for determining whether there were any statistically significant differences between the means of the two independent groups. The results, which indicate there is a significant difference between the mean performance scores of male and female students, are illustrated in the subsequent Table 2, showing the mean scores for each gender along with error bars representing the standard error of the means

Table 2: ANCOVA Results of Significant Difference in the Mean Performance Scores of Pre and Post-tests Scores for Male and Female Students in the Experimental Group.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Effect Size
Corrected Model	13502.844[a]	2	6751.422	20.386	.000	.459[a]
Intercept	22195.596	1	22195.596	67.020	.000	.583
Pre -test Performance	68.093	1	68.093	.206	.652	.004
Gender	13388.698	1	13388.698	40.427	.000	.457
Error	15896.567	48	331.178			
Total	190345.000	51				
Corrected Total	29399.412	50				

a. R Squared = .459 (Adjusted R Squared = .437)

Table 2 the results of the Analysis of Covariance (ANCOVA) test on the mean performance scores between male and female students taught Mathematics using a virtual classroom strategy are presented. The result in table 2 shows that F (1, 51) = 40.427 with an effect size of 0.457 and a p-value of less than .001. Since the observed p-value was less than the alpha value of 0.05, there is a significant difference between the mean performance scores of male and female students. As a result, the null hypothesis (HO_6) stating that there is no significant difference between the mean performance scores of male and female students taught using the virtual classroom strategy is rejected. Therefore, it is concluded that there is a difference between the mean performance scores of male and female students taught mathematics using the virtual classroom strategy.

Discussions

The result of ANCOVA analysis in Table 1 revealed the rejection of null hypothesis Ho_1 which implied that significant difference exists between the mean performance scores of students taught Mathematics using the virtual classroom strategy and those taught by using conventional method. This means that students taught Mathematics concepts by using the virtual classroom strategy performed significantly higher than those exposed to the conventional method. This finding agrees with the finding of Regad et al. (2019) who also maintained that virtual classroom strategy significantly improves students' performances than the conventional method. Furthermore, the finding based on this null hypothesis agrees with the finding of Ma and Raymond (2023). They maintained that, students exposed to the virtual classroom strategy in Mathematics performed significantly higher than those exposed to the conventional method. Jan-Dominic, (2022) also revealed a similar finding. The finding reflected the finding of Salami (2023) who reported that virtual learning has a positive impact on the performance of students as compared to traditional learning and male students performed positively higher than their female

counterparts through the use of virtual learning.

The ANCOVA test in Table 2 the gender difference concerning the independent variable. Similarly, this research is not left out; it explored the gender difference in performance mean scores of students taught Mathematics by using a virtual classroom strategy. The null hypothesis associated with the earlier statement was rejected. This ascertained that when innovative teaching approaches were employed, the gender differential could not be bridged, because sometimes females have higher anxiety in handling computer gadgets. The finding proves that males can perform better than females when taught Mathematics by using a virtual classroom strategy. The finding related to this null hypothesis was supported by Salami (2023) who equally maintained that result of the findings showed that virtual learning has a positive impact on the performance of students as compared to traditional method. Male students performed positively higher than their female counterparts through the use of virtual learning. Similarly, this finding supported by Muhammad and Abdullahi (2023) who they revealed that mostly males performed rigorous activity than the female counter part. Additionally, there are observations of differences between Men and Women report higher social fear compared to men in virtual reality, with successful social fear conditioning in both low and high socially anxious individuals (Reichenberger et al., 2019).

Conclusions

It was concluded based on the findings of the study that:

1. The use of virtual classroom strategy enhances the quality of understanding and performances of mathematics concepts of students in experimental group than the students in the counterpart.

2. Virtual classroom strategy enhances the quality of understanding of Mathematics concepts of male students.

Recommendations

Based on the findings of this research, the following recommendations were made:

1. The NTI-BDP Mathematics teachers should incorporate virtual classroom strategy in their teaching process in mathematics concepts.
2. NTI should organize workshop to train its Facilitators on the use of virtual classroom strategy on the teaching of various Mathematics concepts.
3. Virtual classroom strategy should use by NTI-BDP Mathematics teachers to teach male and female student in mathematics.

REFERENCES

Alstete, J. W., & Beutell, N. J. (2019). Performance indicators in online distance learning courses: a study of management education. *Quality Assurance in Education, 12*(1), 6-14.

Anekwe, J. U. (2017). Impacts of Virtual Classroom Learning on Students of Nigerian Federal and State Universities. *European Journal of Research and Reflection in Educational Sciences (5)* 3, 21.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84(2),* 191-215.

Bandura, A. (1997). *Self-efficacy: the exercise of control*. New York: W. H Freeman.

Jegede, D. (2020). Perception of undergraduate students on the impact of COVID-19 pandemic on higher institutions development, Federal Capital Territory Abuja, Nigeria.

Kassaw, C., & Demareva, V. (2023). Determinants of academic achievement among higher education student found in low resource setting. A systematic review. *Plos one*, *18*(11), e0294585.

Mbacho, N. W. (2018). *Effects of jigsaw cooperative learning strategy on students' achievement in secondary school mathematics in Laikipia East District, Kenya* (Doctoral dissertation, Egerton University).

National Policy on Education (FRN, 2013) 6th Edition. Kwali, Abuja: NERC Press