



Effect of Digital Technology-Integrated Instruction on the Academic Achievement of Senior Secondary School Students in Mathematics in Abia State, Nigeria

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Abstract

This study was designed to investigate the effect of Digital Technology -Integrated Instruction on Academic Achievement of Senior Secondary Students in Mathematics in Abia State, Nigeria. This study adopted pre-test and post-test quasi-experimental design. Two specific purposes, two research questions and two null hypotheses guided this study. The population of the study consisted of 3,150 Senior Secondary (SS1) mathematics students of 2021 /2022 academic session and the sample size consisted of one hundred (100) students purposively selected in two co-educational schools. The sampled schools comprised forty-eight (48) male students and fifty-two (52) female students. Two intact classes were used. One intact class was for the control group and the other for experimental group. The instrument used for collection was Mathematics Achievement Test (MAT). The instrument was validated by two mathematics experts and an expert in Measurement and Evaluation with the reliability coefficient of 0.82. Research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Results showed that digital technology-integrated instruction was effective in enhancing students' academic achievement in mathematics as students taught using the strategy had mean achievement scores of 61.64 and a mean score of 47.24 for those taught using the conventional method. Furthermore, gender has significant influence on students' academic achievement in mathematics when taught using digital technology -integrated instruction. The mean achievement scores of male students taught Mathematics using the strategy was 63.0 in favour of the male students. Recommendations were made which include among others that mathematics teachers should consider implementing the use of digital technology-integrated instruction in teaching –learning of mathematics concepts thereby making the teaching student-centered. This will solve the problem of poor academic achievement of senior secondary school mathematics students.

Keywords: Academic Achievement, Digital Technology-Integrated Instruction, Gender, Lecture Method, Mathematics

Introduction

Mathematics is one of the most important school subjects in the curriculum worldwide. It is a subject that has a direct relationship with other subjects, particularly technical and science subjects. Mathematics is a subject taught at both public and private schools at all levels (Nwafor, 2022). . Mathematics plays a vital role in all aspects of life, especially in everyday matters such as driving, and in professions such as accounting, finance, banking, engineering and softwares (Yadav, 2019). Mathematics helps in analytical thinking. While solving mathematics

problems, data is collected, disassembled and then interconnected to solve them. Mathematics helps to develop the ability to think, explains how things work, develops wisdom, increases the speed of instruction, makes a child smarter and provides the child with an opportunity to get to the world. Mathematics is pillar of organized life for present day (Eze, 2016). Without numbers and mathematical evidence, one cannot resolve any issues in one's daily lives, it is the main subject of life. Mathematics provides an effective way of building mental discipline, helps to manage times

and plan things, encourages logical reasoning and mental rigor, helps in the development and refinement of personality through organization and accuracy, research and investigation. Mathematical knowledge plays a crucial role in understanding the contents of other school subject such as science, social studies, music and art. Mathematics encourages critical thinking, creative thinking, abstract or spatial thinking, problem-solving ability and even effective communication skills. Mathematics gives ways to understand patterns, define relationship and predict the future. It is the universal language that is applied in almost every aspect of life. Mathematics is an important school subject because of its educational values which includes; disciplinary values, aesthetic value, social values, intellectual, moral, practical and vocational values. These values are in line with the general aim of teaching mathematics which includes; utilitarian aim, disciplinary aim, cultural and vocational aim (Patel, 2023).

According to WAEC released online results (2017), only 42.73% of the students who sat for Mathematics in 2017 WAEC obtained A1 -C6, 37% obtained D7-E8 while 27% had F9. This poor achievement by Mathematics students could be attributed to the fact that students hate and/or dislike mathematics and as such absent themselves from mathematics lessons and those who stay in the lesson pay little attention to the teacher teaching the subject (Ezike, 2018)). Because of the importance of Mathematics, there is a need for it to be properly taught in secondary schools to create an atmosphere that will enable them to respond positively to the subject and this will help to improve students' achievement. According to Ernest-Ehibudu and Oporum (2023), the measure for assessing students' level of academic achievement is through achievement tests/examinations and observations. In Nigeria, academic achievement at secondary schools level determines who proceeds to higher institution. Ezike (2018) stated that many prospective graduands of secondary education have been frustrated out of further education simply because they were not able to acquire the needed grades to qualify them for the Unified Tertiary Matriculation Examination. According to Afuwape (2024), teaching and learning should involve innovative methods that promote the development of critical thinking skills which are embedded in creativity that can be used to ensure meaningful learning for enhancing academic achievement. In today's technology-driven world,

conventional methods of teaching mathematics are not enough.

The conventional method of teaching Mathematics which has been the generally accepted way of teaching is teacher-centered and does not inspire learners to think. In this modern World almost all kinds of professions demands innovation, creative thinking, flexibility and practicality, conventional method of teaching has not met these needs as learners sit and inactively listen to the teacher, talk when approached and do as they are told. This constrains intellectual capability thereby making learners lose interest in the learning. In order to improve students' academic achievement in Mathematics, teachers should be able to develop and apply modern strategies such as Digital technology-Integrated Instruction that gives students the opportunity to be active during learning thereby discovering new knowledge. The dawn of the 21st century is characterized by digital technology as seen in the speed and ease of information dissemination, cheaper and better ways of communicating globally as well as easy and enhanced means of teaching and learning in the various institutions of learning. These great improvements in digital technology are the 'brain-child' of the greatest innovation in the history of science and technology- the Computer. The computer is not just a teaching tool like chalkboard or textbook, it is rather one of the devices used as digital technology-integrated instruction that provides students with interactive involvement with instructional materials. Computers are used to show virtual models of mathematics at mathematics virtual library to create graphs more easily as online collaboration tools as well as social media applications are the popular choices for students (Demuyakor, 2020). In this study, the computer is one of the digital technology devices used as an instructional material in digital technology learning strategy (DTII) to fascinate teaching and learning. The use of computers as a learning medium or strategy is referred to as Digital Technology Integrated Instruction Strategy.

Digital Technology-Integrated Instruction is an automated instructional technique in which a computer is used to present an instructional programme to the learner through an interactive process (Adedokun, 2022). Digital technology integrated instruction with shared global resources have brought a more flexible and dynamic learning environment beyond the traditional method which regarded classrooms as the only dominant environment for formal Education. Audu and Agbo (2020) viewed Digital Technology -

Integrated Instruction (DTII) as a strategy in which a digital device such as the computer is used to instruct students, this is because the computer contains a stored instructional programme designed to inform, guide, control and test the students until a prescribed level of proficiency is reached. DTII can be applied to all ages and forms of education, from preschool to professional school and even in many employment areas as well as across both genders (Okebukola, 2023).

There is a large gap in women and girls' digital adoption and use compared to men and boys. This gender gap in digital access is accompanied by gender gap in meaningful digital technology use. These disparities in DTII limit the females' access to the full range of opportunities offered by digital technology especially in the areas of teaching and learning mathematics. According to Tyers and Banya (2020), boys use far more digital platforms and services for a much wider range of activities than girls and they are more likely to use the internet. There are different views on the effect of DTII on academic achievement across gender.

A study conducted by Odogwu (2022) on the effect of computer assisted instructions on the achievement of senior secondary school students in mathematics. The result showed that there was a significant difference in the mathematics achievement of the experimental group. Also, there was no significant gender difference in the achievement of students taught with digital. Agwagah, *et al* (2019) carried out a study on the effect of digital technology learning strategic approach on students' achievement in mathematics. The result of the study revealed that the computer teaching approach has a significant effect on students' achievement in Mathematics. Obodo, *et al* (2019) carried out a study on the effect of digital technology on students' achievement in Basic Science and Technology in Udi educational zone, Enugu State, Nigeria. The findings revealed that those taught with digital technology achieved higher in Basic Science Technology than those taught with conventional methods. Zainab (2021) carried out a study on the effect of the internet –based tools on performance of senior secondary students in Biology in Kaduna State. The findings of the study revealed that there is a significant difference in the performance of Biology students taught using internet –based learning tools and those taught with lecture methods.

There are divergent views on the effects of the various teaching and learning methods on the students' academic achievement in different subjects. Igwe

(2023), opines that education has been improved tremendously through the process of digital technology learning strategy in teaching other subjects. However, limited studies considered the effects of digital technology learning strategy on students' academic achievement in Mathematics. This study is therefore designed to investigate the impact of digital technology integrated instruction on students' academic achievement in Mathematics in secondary schools in Abia State, Nigeria.

Research Questions

1. What is the difference in the mean achievement scores of students taught mathematics using digital technology-integrated instruction and those taught using conventional methods?
2. What is the difference in the mean achievement scores of male and female taught mathematics using digital technology- integrated instruction?

Hypotheses

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

- Ho₁: There is no significant difference between the mean achievement scores of students taught mathematics with digital technology -integrated instruction and those taught using conventional methods of teaching.
- Ho₂: There is no significant difference between the mean achievement scores of boys taught mathematics with digital technology integrated instruction and the girls taught using the same strategy.

Research Method

The design for the study is quasi- experimental design. The population used in this study was 3,150 Senior Secondary (SS1) Mathematics students (comprising 1,277 male and 1,873 female students) in the three education zones of Abia state, (SEMB, 2025). The Senior Secondary One (SS1) students were chosen for this study because it is a foundation class and using this learning strategy to lay the foundation of Mathematics learning will help to foster interest, understanding, value for the subject and the necessary independence needed to do personal study for improved performance. The sample size for this study was 100 students (48 males and 52 females). The control group had 50 students and the experimental group equally had 50 students. Random sampling technique was used to

select one educational zone from the 3 zones in Abia state. This was to ensure that each member of the population had an equal chance of being selected. Purposive sampling technique was used to select one co-educational school that has up to two streams in the sampled zone. One intact class was used as a control group and another as an experimental group. The instrument used for this study was Mathematics Achievement Test (MAT) which consists of 50-items multiple-choice questions. The pre-test was the same with post-test except that the researcher re-shuffled the question items to make them look different. The instrument was validated by three experts; two experts in Mathematics Education, and one in Measurement and Evaluation, Department of Science Education, Michael Okpara University of Agriculture, Umudike. Kuder Richardson 20 was used to determine the reliability of the instrument and a reliability index of 0.82 was obtained. Mean and standard deviation were

used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. In testing the hypotheses, the hypothesis of no significant difference will be rejected where the P-value is less than the Alpha (α) value of 0.05, while it will not be rejected where the P-value is equal to or greater than the Alpha (α) value of 0.05. Digital technology-integrated instruction was used for the experiment, This experiment was conducted during normal school periods. The teacher in each group was allowed to teach for 40 minutes. Students in both groups were post -tested with MAT. The regular class teachers in the sampled schools were used for both control and experimental groups. The researcher prepared the lesson notes and ensure adequate coverage of the teachers and students activities. These measures were taken to control the extraneous variables that may arise in the study.

Results and Findings

The results of this study are presented in the tables below

Table 1: Mean Achievement scores and standard deviations of students taught mathematics with digital technology and those taught with conventional method

Variables	N	Pre-test Mean	SD	Post-test Mean	SD	Mean Difference
DTII Group	50	44.82	8.37	61.64	11.50	16.82
Control Group	50	44.44	8.90	47.24	7.59	2.80

Table 1 above shows the mean achievement scores and standard deviation of students taught mathematics using DTII and those taught using the conventional teaching method. The pre-test mean of those taught using the conventional teaching method was 44.44 and standard deviation of 8.90 with a post-test achievement mean of 47.24 and standard deviation of 7.59. For those taught with the digital technology, the

pre-test mean was 44.82, standard deviation of 8.37 and a posttest achievement mean of 61.64 with a standard deviation of 11.50. The table also shows a mean difference of 16.82 for DTII and 2.80 for conventional methods. This indicates that students taught using the DTII recorded a higher mean achievement score than those taught using the conventional method.

Table 2: Analysis of Covariance on the mean achievement scores of students taught mathematics with digital technology and those taught with conventional method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	48.740 ^a	1	48.740	.331	.567
DTII	9146.138	1	9146.138	62.047	.000
PRETEST	48.740	1	48.740	.331	.567
Error	14445.900	98	147.407		
Total	310866.000	100			
Corrected Total	14494.640	99			

Results in table 2 shows that there is significant difference in the mean achievement scores of students taught mathematics with DTII and those taught with conventional method with p-value of .000 at 0.05 level

of significance. Therefore, the null hypothesis which states that there is no significant difference between the mean achievement of students taught with DTII and those taught using conventional methods is rejected.

Table 3: Mean and standard deviation of achievement scores of boys and girls taught mathematics with the same method.

DTII Method	N	PRETEST Mean	SD	POST TEST Mean	SD	Mean Diff
Male	24	44.125	8.69	63.00	11.909	18.875
Female	26	45.46	8.17	60.38	11.20	14.92

When N= Number of respondent, Sd= Standard Deviation

Results in table 3 shows that the boys taught Mathematics with Digital Technology -Integrated Instruction had mean achievement scores of 63.00 and standard deviation of 11.90 more than their girls

counterpart who had mean achievement scores of 60.38 and standard deviation of 11.20. The boys had a mean and standard deviation score of 44.125 and 8.68 during pretest while the girls had 45.46 and 8.17 at pre-test.

Table 4: Analysis of Covariance on the mean achievement scores of boys and girls taught mathematics with digital technology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3161.398 ^a	17	185.965	3.597	.036
Intercept	1221.118	1	1221.118	23.621	.001
Pretest	171.353	1	171.353	3.315	.106
Gender	3159.031	16	197.439	3.819	.030
Error	413.564	8	51.695		
Total	106643.000	26			
Corrected Total	3574.962	25			

a. R Squared = .884 (Adjusted R Squared = .638)

Table 4 shows that with respect to the mean achievement scores of students taught with DTII The boys had a significant value of 0.030 which is less than the p-value of 0.05 Since the p-value is greater than 0.030, the null hypothesis which states that there is no significant difference in the mean achievement scores of boys taught mathematics and girls taught with the same method is rejected.

Discussion of Findings

Data collected here showed that DTII had a major effect on students' achievement in mathematics. The data revealed that students taught mathematics using DTII had the highest mean achievement scores compared to those taught using lecture methods. The finding of this study is in line with Obodo, *et al* (2019) whose findings revealed that students taught with digital technology achieved higher in Basic Science Technology than those taught with conventional methods. Similarly, Odogwu (2022) found out that there was a significant difference in the mathematics achievement of the group taught with digital technology and those taught with lecture methods. Also, there was no significant gender difference in the achievement of students taught with digital technology-integrated instruction. Agwagah, *et al* (2019) also found out that the computer teaching approach has a more significant effect on students' achievement in Mathematics than the lecture method.

Conclusion

The study investigated the effect of digital technology -integrated instruction on students' academic achievement in mathematics. From the findings of the study, Digital Technology -Integrated Instruction significantly improved students' academic achievement when used in teaching mathematics. Those students taught mathematics using DTII had higher

achievement than those taught using the conventional method. Gender had a significant effect on students' achievement when taught using DTII, but both boys and girls benefitted from the strategy as there was a difference in pretest and post test scores hence DTII can be used irrespective of the students' gender.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. Mathematics teachers should consider implementing digital technology-integrated instruction in teaching-learning of mathematics as the strategy makes learning student-centered. This has the potential of improving students' academic achievement in mathematics.
2. Gender biases should be eliminated in the teaching-learning process and environment as both boys and girls should be given equal opportunity to interact and participate in the teaching-learning process.
3. Curriculum developers should instill the use of DTII as they make an effort to improve the effectiveness of mathematics curriculum.
4. Government and professional bodies should sponsor further research on the use of DTII and support school management in providing digital technology integrated devices required for DTII in schools.

References

- Adedokun, M. (2022). Construction and Effectiveness of Computer Aided Instruction (CAI) Programmed for the Units of Science and Technology of Standard viii. *International Journey of Research in Education*, 2 (1), 112-115
- Demuyakor, J.(2020) Covid-19 Pandemic and Higher Education:Leveraging on



- Digital Technologies and Mobile Application for Online Learning in Ghana. <https://orcid.org/0000-0002-8084-6951>
- Elaine, J. & Jonathan, G. (2021). What in Mathematics? Ernest- Ehibudu, K. & Opuru, P. (2023). Effects of Intensive Computer Simulation Package on Senior Secondary School Students' Achievement and Retention in Genetic Concepts. *Asian Journal in Technology*, 15(14), 2313-2321
- Eze, A. (2016). The Relevance of Mathematics in Science and Technology. *Bobanea Bi-Annual Multi-disciplinary Journal of Education*, 4(7).
- Ezike, B.U, Obodo A.C (2018). Classroom Environment and Academic Interest as Correlation of Achievement in Senior Secondary School Chemistry in Ibadan South West Local Government Area. Oyo State. Nigeria, *Global Journal of Education Research*. 17,61-17.
- Flexible Teaching and Learning Modalities in Undergraduates Science Amid the Covid-19 Pandemic, Published 14 January 2021.
- Igwe, I.O (2023). Principles of Sciences and Science Teaching in Nigerian. (An Introduction). Enugu Jones Communication Publishers
- Nwafor, E. (2022). *Educational Research Basic Issues and Methodology* (Second and first edition). Nsukka Enugu: University Trust Publishers
- Obodo, A.C, Animercy, I. & Okolo. P. (2019). Effect of Digital Technology on Students' Interest and Achievement in Basic Science and Technology. *The Educational Psychology*, 4,(1), 203.
- Odogwu, M. (2022). Gender Differences in Achievement in Calculating Reacting Masses from Chemical Equations among Secondary School Students in Makurdi Metropolis Educational Research. *Review* 1(6), 170-173
- Tyler, R.& Bana, L. (2020). Teaching with Digital Technologies. www.education.vic.gov.au
- Yadav, S. (2019). Roles of Mathematics in the Development of Society. *Nov. Vol. 6 ISS4*
- Zainab, Z. (2021). Effects of Internet-based Tools on Performance of Senior Secondary School Students in Biology IN Kaduna State, Nigeria. *International Journal of Education and Research*. Vol. 9 No.8 August 2021.