LGJDX ISSN No: 1008-0562 Journal Of Liaoning Technical University Natural Science Edition

BLENDED LEARNING AND DATA-DRIVEN INSTRUCTION IN MATHEMATICS: ENHANCING EDUCATOR CAPACITY AND STUDENT ACHIEVEMENT FOR SUSTAINABLE EDUCATION POLICY AND LEGAL REFORM

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Abstract

The quest for sustainable educational development necessitates innovative teaching models that effectively blend pedagogy with digital technology and data-informed practices. This study examines the role of blended learning and data-driven instruction (DDI) in enhancing educator capacity and improving student achievement in Mathematics. This core subject underpins scientific and technological advancement. Anchored in the Sustainable Development Goal 4 (SDG 4) framework and the discourse on education policy reform, this research employs a mixed-methods approach to investigate the effectiveness of blended learning and DDI in Nigerian secondary schools. It also assessed the moderating influence of classroom participation and gender on learning outcomes. Using a quasi-experimental pretest-posttest control group design, the research was conducted in six schools, with two as the control group. Data were gathered using validated instruments: Mathematics Achievement Test, Mathematics Attitudinal Scale, and a Classroom Observation Checklist. Analysis via ANCOVA revealed that DDIS significantly improved pre-service teachers' lesson preparation and delivery, and markedly enhanced student achievement in mathematics. Findings reveal that these approaches significantly improve educators' instructional competencies and student academic performance. The study recommends strategic policy reforms, legal frameworks, and capacity-building initiatives to institutionalize these practices within Nigeria's education sector.

Keywords: Blended learning, data-driven instruction, Mathematics education, educator capacity, student achievement, sustainable education policy, legal reform.

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1. INTRODUCTION

Mathematics is crucial for economic growth, as it underpins industries, informs policy decisions, and enables innovation. A strong foundation in mathematics is also linked to improved job opportunities and economic prosperity. The incorporation of technology and evidence-based strategies is restructuring instructional practices in modern scholastic settings, particularly in the teaching of Mathematics. Blended learning, an instructional methodology that combines conventional face-to-face teaching methods with digital learning tools, has emerged as a powerful method to personalize learning, foster student engagement and improve academic achievements[2]. Blended learning atmospheres help learners to learn to mastery at their own stride when employed efficiently, while letting instructors to offer discriminated provision centered on individual specific needs. Corresponding to the upsurge of blended learning is the prominence on data-driven instruction (DDI), a methodical approach where teachers use student performance data to inform teaching policies, curriculum development and intervention planning[3]. In Mathematics education, DDI enables teachers to identify learning gaps, modify instructional methods and monitor progress in instantaneously, thus improving student learning outcomes and instructional attainments. Significant problem in the process of teaching and learning is the instructional method utilized to teach students in other to impart knowledge which sometimes leads to Students' poor performance in Mathematics. This poor performance is ascribed to both teachers and students' factors especially when the subject in question is poorly taught by teachers at all levels especially secondary schools in Ekiti State, Nigeria[4].

[1]Kehinde-Dada O.V College Students' Preconceptions of Electronic Resources, Relevance and Benefits for an Accurate and Reliable Teaching/Learning Process in the Modern World (2025). *BOUESTI Journal of Education* ISSN: 159-2038 Published by TETFUND *Vol. 1 No1. Pg. 24-31*

[2]Clayton M. Christensen, Michael B. Horn, and Heather Staker, *Blended: Using Disruptive Innovation to Improve Schools* (San Francisco: Jossey-Bass, 2015).

[3]Ellen B. Mandinach and Erika G. Gummer, "What Does It Mean for Teachers to Be Data Literate: Laying Out the Skills, Knowledge, and Dispositions," *Teaching and Teacher Education* 60 (2016): 366–376. https://doi.org/10.1016/j.tate.2016.07.011.

[4]Kehinde-dada O. V Assessment of an Instructional Strategy on Pre-service Teachers' Lessons Delivery in Mathematics in Ekiti State, Nigeria (2020). Journal of College of Education Ikere-Ekiti. Published by TETFUND Vol.2 No1. Pg 1-8.

Studies have revealed that teachers use a wide variety of tactics in the process of teaching and learning of which few of these strategies include direct instruction, personalized systems of instruction, and cooperative learning[4] but still appears none of these tactics has been able to permanently address the issue of children' subpar mathematics performance. Mathematics

teachers are faced with numerous challenges that begin from but not limited to lack of teaching aids, teaching methods, mastery of the course content, phobia to digital technology and literacy and insufficient qualified tutors. Blended learning is panache of teaching/learning process in which students acquire via electronic and online media as well as the conventional face-to-face teaching. Unfortunately, this is what is trending currently among higher institution in which major Colleges in the universities are yet to move in the trend of educational sustainability. Furthermore, the prevalent accessibility of information and communication technology (ICT) has changed tertiary Institution into multi-choice learning atmospheres that balance classroom learning experience and upturn learning centered on specific preference, which is self-governing of time and place[5].

Blended learning is really Hybrid learning it is a mixture of traditional classroom (face-to-face learning) with online learning activities and material that allows more rick and engaging experiences. A blend is traditional instructor-led training, synchronous virtual conferencing or training and self-paced asynchronous learning. The blended culture meshes a variety of activities – physical classrooms, e- learning, and self- paced learning. In the beginning, blended learning remained habitually concomitant through basically linking conventional classroom teaching with e-learning activities; conversely, the span has currently advanced to embrace an ample amusing set of learning stratagems and combination of different dimensions is referred to as blended learning, this observation has now made educators and researchers realize that the two models are structurally different and hence the mere translation of traditional material in online mode can never become a successful program[6].

[4]Adeyele 2024. Relative Effectiveness of Simulation Games, Blended Learning, And Interactive Multimedia in Basic Science Achievement of Varying Ability Pupils Education and Information Technologies (2024) 29:14451–14470 https://doi.org/10.1007/s10639-023-12414-zS

[5]Parmjit Singh and Gurmit Kaur, "The Teaching and Learning of Mathematics through Multiple Intelligences," *Journal of Education and Practice* 7, no. 3 (2016): 45–53.

[6]Kehinde-Dada, Effects of Blended Learning on Students' Academic Achievement in General Studies Among Nigerian Undergraduates during Global Turbulence Era (2024) *Journal of the Department of Economics, Lagos State University, Lagos, Nigeria.* Free Enterprise Publishers *Vol. 6 No 1.Pg.170-192* Nigeria.

The emphasis placed on teachers in the meaningful development of educational system at all levels is being felt in the National Policy on Education (NPE) that no system of education can rise above the quality of its teachers[7]. This statement highlights the importance of quality teaching and learning of mathematics at all levels, from primary schools through to the tertiary

level. The best antidotes to these problems, it appears, are not too easy to reach classroom based on the poor state of mathematics in the country as the end result of neglecting affective domain aspect like attitude, class participation, interest and others in mathematics.

Achievement in the classroom is referred to as the mark changed measured in an individual after being exposed to a kind of treatment like teaching, training, practical or any form of instruction. This is undoubtedly measured by test score before and after the treatment. To examine what controls the academic achievement of learners, there are numerous questions to answers. Recently, literature shows that variables such as; family, school, society, and motivation factors determines learning outcomes[8]. Secondary school student's academic performance is basically connected to various influences. Nigeria secondary schools students are faced with day-to-day challenges like the trials of managing their academics situation with severe emotional stresses caused by trekking to school, poor school environment factor, poor feeding, low standard of living, parental background and being tutored by unenthusiastic teachers. Additionally, mostly students from low social economic background experience diverse difficulties in school unlike students with high social economic background who do not encounter such problem, such students do not give positive attention to their studies causing low performances in their courses especially in Mathematics. This poses difficulties in teaching learning process for tutors, learners and all stake holders including policy makers in educational sectors.

[7]Federal Republic of Nigeria (FRN), *National Policy on Education*, 7th ed. (Lagos: Nigerian Educational Research and Development Council [NERDC], 2016).

[8]Martins et al., 2023; Sun & Wang, 2019; Ajayi, A. O., & Ayodele, A. O. Motivational Factors and Academic Performance of Senior Secondary School Students in South-West Nigeria (2023). *International Journal of Social Science and Humanities Research, 6(6), 261–271.* https://www.ijsshr.in/v6i6/28.php

In spite of entirely continual struggles to advance the teaching/learning process of Mathematics, students' performance in Mathematics seems not to improve. Researchers in Education recommended innumerable instructional approaches that possibly will increase students' achievement in Mathematics such as good teaching methods, positive attitude to the subject, period of teaching and learning[9]. Enlightening training in Mathematics lessons has lingered a foremost concern for educators, investigators, administrators and the community. The importance of instructors cannot be ignored if meaningful learning is expected to take

place. They perform an essential character in scholastic growth based on the colossal tasks put on them for the interpretation and enactment of curriculum, instructional tools as well as measuring students' learning outcomes. Many junior secondary school mathematics instructors in Nigeria, who received their training at colleges of education, struggle to write lesson plans and present Mathematics lessons[10].

The effectiveness of data-driven instruction in the English language has hitherto been the main focus of research, with less attention paid to the lesson planning and delivery of pre-service teachers or the mathematical learning results of junior secondary school pupils[11]. However, successful implementation of these approaches requires systemic support through sustainable education policies and legal frameworks [12]. This study explores how blended learning and DDI can enhance Mathematics educators' capacity and students' achievement in Nigeria, contributing to education policy and legal reforms that align with SDG 4 targets[13].

[9]Oluwabunmi V. Kehinde-Dada, Olusola Obisanya, and Gbenga Adewale, "Effects of Data-Driven Instructional Strategy on Pre-Service Teachers' Mathematics Lesson Preparation in College of Education Ikere-Ekiti," in *Globalized Curriculum Methods for Modern Mathematics Education*, ed. [Editor's Name if known] (Hershey, PA: IGI Global, 2019), 75–92, https://doi.org/10.4018/978-1-5225-6158-3.ch006.
[10]E. C. Okafor and T. N. Akinlosotu, "Effect of Activity-Based Instructional Strategy on Students' Academic Achievement in Mathematics in Nigeria," *Journal of Educational Research and Practice* 11, no. 3 (2021): 45–57, https://doi.org/10.5590/JERAP.2021.11.3.04.
[11]Ellen B. Mandinach and Edith S. Gummer, "Data-Driven Decision Making in Education: The Role of theTeacher,"*TeachersCollegeRecord*118,no.2(2016):1–26, https://doi.org/10.1177/016146811611800201.
[12]UNESCO, *Education for Sustainable Development: A Roadmap* (Paris: UNESCO, 2020), https://unesdoc.unesco.org/ark:/48223/pf0000374802.
[13]United Nations, *The Sustainable Development Goals Report 2023* (New York: United Nations, 2023), https://unstats.un.org/sdgs/report/2023.

Studies revealed that students taught using activity-based methods performed significantly better than those taught using traditional lecture methods, highlighting the importance of innovative teaching strategies in improving mathematics performance. While these studies provide valuable insights into the causes of poor mathematics performance, there is a noticeable gap in the literature regarding the implementation of data-driven instructional strategies specifically for mathematics at the secondary school level in Nigeria. Most existing research on data-driven instruction focuses on subjects like English Language, Geography, and Basic Science [14].

For example, Bambrick-Santoyo's[15] work on data-driven instruction primarily addresses elementary education and does not extensively cover mathematics instruction at the secondary level. This highlights the need for further research and implementation of data-driven instructional approaches tailored to mathematics education in Nigerian secondary schools.

By implementing blended learning and an instructional driven by data, method in the teaching and learning process, this study addressed that gap. It is on this statement that this study evaluates blended learning and data-driven instructional strategy (DDIS)' effects on pre-service teachers' lesson planning, class delivery and students' achievements in secondary school mathematics. Studies should pay more attention to the moderating effects of student engagement in class, pre-service teachers' (instructors') gender, and students' gender. In the teaching-learning procedure, instructor would establish core curriculum content and impart with the intention of aiding learners to overcome obstacles to learning. Numerous strategies for improving mathematics instruction in secondary schools have been developed, including problem-solving, computer-assisted instruction, individualized instruction, guided inquiry, laboratory, demonstration, and team teaching[16]. However, because of the school culture, these strategies have been abandoned.

[14]Clayton M. Christensen, Michael B. Horn, and Heather Staker, *Blended: Using Disruptive Innovation to Improve Schools* (San Francisco: Jossey-Bass, 2015).
[15]Bambrick-Santoyo, P.. *Driven by Data. A practical guide to improve instruction*. Jossey-Brass a Wiley Imprint 989 market, San Franciso, CA 94103- 1741(2010).
[16]Bambrick-Santoyo, P. *Driven by Data. A practical guide to improve instruction*. Jossey-Brass a Wiley Imprint 989 market, San Franciso, CA 94103- 1741(2010).

Introducing an innovative instructional approach that can lessen the challenge like data driven instruction strategy is very essential. This study also investigated and examined how blended learning and DDI can enhance educator capacity and student achievement in Mathematics, contributing to policy and legal reforms necessary for sustainable education systems. In alignment with Sustainable Development Goal 4 (SDG 4)[17], which advocates for inclusive and equitable quality education, there is a growing need to explore how these approaches can be leveraged to improve Mathematics education. Furthermore, sustainable education policies and legal frameworks must be responsive to the integration of technology and data use in classrooms. The study also examined the level at which pre-service teachers

would use blended learning and data-driven instructional strategies to advance students' attainment in mathematics and also provide teachers with information on every individual student's performance and improvement in teaching-learning process.. Two research questions were raised for this study:

Research Question 1: To what extent does the integration of blended learning and data-driven instruction improve Mathematics educators' instructional capacity in Nigerian secondary schools?

Research Question 2: What is the effect of blended learning and data-driven instruction on students' achievement in Mathematics, and how do these approaches support sustainable education policy and legal reform in Nigeria?

Review of literature revealed that instructional strategy of the instructor, which is a significant feature is considered a main trial in the teaching/learning process of mathematics.

2. LITERATURE REVIEW

2.1 Theoretical Framework

This study draws on two key theoretical underpinnings: constructivist learning theory and data-informed decision-making frameworks in education. Constructivism, particularly the social constructivist perspective advanced by[18], emphasizes that learners build knowledge through social interaction and contextual experiences[19]

[17]United Nations, *The Sustainable Development Goals Report 2023* (New York: United Nations, 2023), https://unstats.un.org/sdgs/report/2023

[18]Jerome Bruner, *the Process of Education* (Cambridge, MA: Harvard University Press, 1960).

[19]Lev S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*, ed. Michael Cole et al. (Cambridge, MA: Harvard University Press, 1978).

Blended learning supports this by enabling collaboration and interaction across physical and digital environments. In parallel, the Data-Driven Decision-Making (DDDM) framework emphasizes the deliberate use of student performance data to inform instructional strategies[20].These theories collectively underpin the rationale for integrating blended learning and data analytics into pre-service teacher training and classroom instruction.

2.2 Blended Learning in Mathematics Education

Blended learning merges traditional instruction with digital tools to provide a more flexible and personalized educational experience. In mathematics education, this approach has been shown to

improve conceptual understanding and problem-solving skills by promoting student engagement and allowing for differentiated learning[21]. Recent studies in sub-Saharan Africa also indicate that blended learning can mitigate access and infrastructure limitations, though challenges persist in teacher digital literacy and technology access[22]. The effectiveness of blended learning is particularly noted when it is paired with well-structured content and continuous teacher support[23]

2.3 Data-Driven Instructional Strategies (DDIS)

Data-Driven Instructional Strategies (DDIS) involve the systematic use of assessment results to inform instructional planning, intervention, and feedback loops. In mathematics, where student misconceptions can be cumulative, DDIS enables teachers to identify gaps early and tailor instruction accordingly. However, the success of DDIS hinges on teachers' data literacy and institutional support for data use[24].

[20] Adarkwah, Bower, Matt & Lee, Mark & Dalgarno, Barney. Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment. British Journal of Educational Technology. (2021) (2016) 48. 10.1111/bjet.12435.

[21] Bijan Sarkar, Souvik Chakraborty "Blended Learning: Combining Traditional and Digital Approaches in Education" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, (2024) URL: www.ijtsrd.com/papers/ijtsrd67269

[22]Kaisara, Godwin & Bwalya, Kelvin Joseph. Trends in Mobile Learning Research in sub-Saharan Africa: A Systematic Literature Review (2022) 18. 231-244.

[23]Long Ma, Chei Sian Lee. Evaluating the effectiveness of blended learning using the ARCS model. Journal of Computer Assisted Learning. (2021) DOI: https://doi.org/10.1111/jcal.1257

[24]Zakaria, Zuraimi & abdul latif, Adibah. Obstacles to Effective Data-based Interventions: A Systematic Review of Teachers' Data Literacy. International Journal of Academic Research in Progressive Education and Development. 1708-1726. 10.6007/IJARPED/v12-i3/19221(2023).

Recent findings emphasize the importance of training pre-service teachers in interpreting data meaningfully, not merely collecting it, to avoid mechanical or compliance-driven practices[25].

2.4 Teacher Capacity Development

Enhancing teacher capacity is a core pillar of sustainable education reform. Pre-service and in-service training that incorporates blended learning and data literacy equips teachers with adaptive competencies for 21st-century classrooms[26].

Effective professional development combines pedagogical theory with practical application, including the use of data for continuous improvement[27]. Studies confirm that teachers who engage with DDIS and blended strategies show marked improvement in lesson planning, instructional delivery, and student assessment practices[28]. Nonetheless, sustainable impact requires institutional frameworks that reinforce and reward continuous professional learning.

2.5 Policy and Legal Implications

The integration of blended learning and DDIS has important implications for education policy and law. Nigeria's National Policy on Education[29] advocates for ICT integration, teacher development, and inclusive learning environments, but lacks strong legal enforcement mechanisms. Embedding DDIS and blended learning within national teacher training standards could support systemic change aligned with the Sustainable Development Goals (SDG 4) and the African Union's Agenda 2063. Moreover, education law must evolve to support digital equity, data protection, and teacher accountability. Recent policy analyses emphasize the role of legislation in institutionalizing pedagogical reforms to ensure they are scalable, equitable, and resilient[30].

[25] Yanan Zhang et al The effect of teacher training programs on pre-service and in-service teachers' global competence (2024): A meta-analysis http://doi.org/10.1016/j.edurev.2024.100627

[26]World Educators Forum, Vol. 12 No. 1, November, 2021 ISSN: 2350-2401Accreditation as an instrument for promoting quality Teacher Education The Nigerian Today, NCCE Abuja (2021) Vol. 10(1) 14-17.

[27] Basri, Hasan. (2024). The Effectiveness of Blended Learning, Digital Literacy Programs, and Teacher Training on Student Outcomes in (2024). Global International Journal of Innovative Research. 2. 1745-1752. 10.59613/global.v2i8.249.

[28]World Bank. Inclusion matters: The foundation for shared prosperity, Washington D.C.: World Bank (2013)

[29] Federal Republic of Nigeria. 2013. National Policy on Education (6th Edition) Lagos: Nigerian Educational Research and Development Council (NERDC).

[30]Olanrewaju, Gideon & Falajiki, Charles & Omotosho, Yetunde & Osama, Godwin & Fatoke, Motunrayo & Ariyo-Agbaje, Ifeoluwa & Awakessien, Mekitmfon. Education Digital Equity Policy guide: Findings and Recommendations for Education stakeholders and Policymakers in Nigeria (2021). 10.13140/RG.2.2.26808.06402.

2.6 Significant of the Study

This study is significant as it provides empirical insights into how blended learning and data-driven instructional strategies (DDIS) can improve the instructional capacity of pre-service teachers and enhance students' achievement in mathematics. By integrating technology with data-informed teaching practices, the research addresses the critical need for more effective and adaptable teaching methods, especially in resource-constrained educational environments. Improving mathematics education is vital for building the scientific and technological skills required for sustainable national development. The findings of this study are also relevant for education policymakers and stakeholders seeking to strengthen teacher preparation programs and promote sustainable education reform. The research offers practical recommendations that can inform policies aimed at embedding blended learning and data-driven approaches into

teacher training and classroom practices. Additionally, the study supports global education targets such as Sustainable Development Goal 4 (SDG 4), contributing to the broader effort to achieve inclusive, equitable, and quality education for all.

3.0 METHODOLOGY

3.1 Research Design

This study employed a quasi-experimental design with a pretest-posttest control group structure. The research design was selected to assess the effects of blended learning and data-driven instructional strategies (DDIS) on both pre-service teachers' instructional skills and students' achievement in mathematics. The quasi-experimental design allows for the comparison of outcomes between a treatment group (exposed to blended learning and DDIS) and a control group (exposed to traditional teaching methods). This design is particularly suited for educational research in field settings where randomization is not feasible [31].

This second stage used a control group that was created and represented as follows: pre-test, post-test:

Experimental group 1 = 01X102 where X1 denotes Data Driven Instructional strategy (DDI)

Experimental group 2 = 03X204 where X2 denotes Blended learning (BL)

Experimental group 3= 05X306 where X3 denotes DDI+BL

Control group = 03--04 where – denotes conventional method of teaching

[31] Gopalan, M., Rosinger, K., & Ahn, J. B. (2020). Use of Quasi-Experimental Research Designs in Education Research: Growth, Promise, and Challenges. Review of Research in Education, 44(1), 218-243. https://doi.org/10.3102/0091732X20903302 (Original work published 2020)

3.2 Population and Sample

The study targeted pre-service teachers enrolled in teacher education programs at universities in Ekiti State, Nigeria and students from six schools were randomly selected. Two school each for experimental and control group, the total population consisted of 54 pre-service teachers in the first phase (training phase), and 300 secondary school students participated in the second phase (implementation phase). A purposive sampling technique was used to select participants for both phases based on their engagement and performance. In phase one, pre-service teachers were selected from those preparing for teaching practice. In phase two, twelve pre-service teachers were selected for inclusion in the experimental group based on their "gain performance" (post-

test score minus pre-test score), ensuring that the most capable teachers were involved in the intervention.

3.3 Data Collection Instruments

Three key instruments were used for data collection in both the face-to-face and blended learning environments:

3.3.1 Mathematics Achievement Test (MAT)

The MAT was designed to assess student performance in mathematics, focusing on key competencies such as problem-solving, reasoning, and procedural fluency. The reliability coefficient for the test was found to be 0.87 using the Kuder-Richardson formula (KR-20). This instrument was administered as both a pretest and posttest to measure academic improvement.

3.3.2 Mathematics Attitudinal Scale (MAS)

The MAS assessed students' attitudes toward mathematics, including their confidence, motivation, and perceived value of the subject. The scale exhibited a high level of reliability ($\alpha = 0.91$) and provided valuable insights into the affective dimension of learning.

3.3.3 Students' Classroom Observation Checklist (SCOC)

The SCOC was designed to observe student participation and engagement in both classroom and e-learning settings. This checklist was used to gather data on students' behaviors, such as their involvement in discussions and their use of learning technologies, with a reliability index of $\pi = 0.92$.

3.4 Procedure

The study was conducted in two phases over a period of 8 weeks. In phase one, pre-service teachers received training in special teaching methods (STM) aimed at enhancing their instructional skills. Of these teachers, a subgroup was randomly selected to undergo additional training on data-driven instructional strategies (DDIS). In phase two, the pre-service teachers implemented the STM and DDIS strategies in a classroom setting with students from local secondary schools. The participating schools were randomly assigned to one of three groups: (1) the DDIS treatment group, (2) the blended learning treatment group, and (3) the control group, which continued with traditional teaching methods. Observations, assessments, and classroom activities were carefully documented to gauge the impact of each instructional strategy.

3.5 Data Analysis Techniques

Quantitative data were analyzed using independent samples t-tests, and regression analysis. Qualitative data were subjected to thematic analysis. Data were statistically significant at a significance level of $\alpha = 0.05$. Descriptive statistics (means and standard deviations) were also calculated to summarize the data before and after the intervention. The main effects of the independent variables (DDIS, blended learning, and control) were analyzed, and the moderating effects of gender and classroom participation were examined. This allowed for a more nuanced understanding of how these variables interact to influencing learning outcomes.

4.0 RESULTS

4.1 Research Question 1: To what extent does the integration of blended learning and data-driven instruction improve Mathematics educators' instructional capacity in Nigerian secondary schools?

Table 1: Teacher Capacity Improvement Before and After Intervention (N = 54)

Capacity Indicator	Pre-Training Mean (SD)	Post-Training Mean (SD)	Mean Difference
Confidence in using blended tools	2.8 (0.9)	4.3 (0.6)	+1.5
Ability to analyze student data	2.5 (0.8)	4.1 (0.7)	+1.6
Use of differentiated instruction strategies	3.0 (0.7)	4.2 (0.5)	+1.2

(Scale: 1 = Very Low, 5 = Very High)

Interpretation: Teachers reported strong gains in digital teaching confidence, data literacy, and differentiation ability after receiving training and implementing blended learning and DDI.

The findings reveal that the integration of blended learning and data-driven instructional strategies (DDIS) significantly enhanced the instructional capacity of Mathematics educators. Pre-service teachers exposed to these approaches demonstrated substantial improvements in lesson preparation, content delivery, and classroom management. Quantitative analysis showed that teachers in the blended learning and DDIS group scored significantly higher in instructional capacity assessments compared to their counterparts using conventional teaching methods (Mean difference = 21.30, $p < 0.01$). Observational data further indicated that these educators exhibited greater confidence in leveraging digital tools, interpreting student performance data, and

adapting their teaching strategies to meet diverse learner needs. These results suggest that blended learning and DDIS are effective in equipping Mathematics teachers with relevant 21st-century pedagogical skills.

4.2 Research Question 2: What is the effect of blended learning and data-driven instruction on students' achievement in Mathematics, and how do these approaches support sustainable education policy and legal reform in Nigeria?

Table 2: Paired Sample t-test Results on Student Achievement Before and After Blended Learning & DDI Intervention (N = 300)

Measurement	Mean (M)	Standard Deviation (SD)	t-value	df	p-value
Pre-test Score (%)	47.20	10.40			
Post-test Score (%)	68.50	12.30	15.76	299	< .001

The results in Table 2 show a statistically significant improvement in students' Mathematics achievement after the implementation of blended learning and data-driven instruction. The mean score increased from 47.20% (SD = 10.40) to 68.50% (SD = 12.30). A paired samples t-test revealed that this difference was significant at the $p < .001$ level, with $t(299) = 15.76$, indicating a strong effect of the instructional intervention on student performance. The study also found that students taught by educators who implemented blended learning and DDIS recorded significantly higher achievement levels in Mathematics compared to those taught through traditional methods.

Table 3: Student Engagement with Blended Learning (N = 300)

Engagement Indicator	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Enjoyed using digital learning tools	58%	30%	8%	3%	1%
Found personalized learning helpful	52%	34%	9%	4%	1%
Felt more motivated during blended classes	47%	39%	10%	3%	1%

Interpretation: Over 80% of students reported increased enjoyment and motivation during blended learning sessions, suggesting a positive shift in learning engagement.

Analysis of students' post-test scores revealed a marked improvement in conceptual understanding and problem-solving skills among learners in the experimental group.

Beyond classroom outcomes, the study underscores the potential of these strategies to inform sustainable education policy and legal reform in Nigeria. The successful integration of blended learning and DDIS demonstrates a viable model for addressing teacher quality, technology integration, and equity in education. Consequently, the findings provide empirical support for policymakers to institutionalize these approaches within teacher training programs, curriculum frameworks, and national education policies, in alignment with Sustainable Development Goal 4 (SDG 4) and Nigeria's broader education reform agenda.

5.0 CONCLUSION

The findings of this study demonstrate that the integration of blended learning and data-driven instructional strategies offers a viable pathway for improving both teacher quality and student achievement in Mathematics within the Nigerian education system. By equipping pre-service teachers with digital competencies and the ability to utilize data for instructional planning, this approach fosters more effective teaching practices, enhances student engagement, and addresses persistent learning gaps in Mathematics, a subject critical to national development and global competitiveness. Beyond the immediate classroom implications, this research highlights the necessity of embedding such innovations within sustainable education policies and legal frameworks. For Nigeria to meet its national education objectives and international commitments, such as Sustainable Development Goal 4, there must be deliberate efforts to institutionalize blended learning and DDIS in teacher training programs, curriculum reforms, and education legislation. This requires not only technological investment but also policy coherence, legal accountability, and stakeholder collaboration. In conclusion, blended learning and data-driven instruction are not merely technical interventions but essential components of a broader, systemic approach to education reform. When supported by strong policy and legal foundations, these strategies can help build an education system that is inclusive, resilient, and capable of producing the skilled human capital needed for sustainable national development.

6.0 RECOMMENDATIONS

Based on the findings of this study, several key recommendations are proposed to enhance Mathematics education and support sustainable education policy and legal reform in Nigeria:

6.1 Integration of Blended Learning and DDIS in Teacher Education:

Teacher training institutions should formally incorporate blended learning and data-driven instructional strategies into their pre-service and in-service training programs. This will ensure that Mathematics educators are equipped with the necessary digital competencies and data literacy to effectively engage students and improve learning outcomes.

6.2 Policy Development for Sustainable Implementation:

The Federal and State Ministries of Education should develop clear policies that promote the integration of technology and data-informed teaching practices in secondary schools. Such policies should outline standards for digital infrastructure, teacher support, and monitoring mechanisms to ensure consistent implementation across schools.

6.3 Strengthening Legal Frameworks for Education Reform:

To support these instructional innovations, it is recommended that relevant legislative bodies review and amend existing education laws to reflect the role of digital learning and data-driven instruction in achieving quality education. Legal provisions should also address issues such as equitable access to technology, teacher accountability, and data privacy protection for students.

6.4 Provision of Digital Infrastructure and Resources:

Governments, in collaboration with private sector partners, should invest in expanding access to affordable digital devices, reliable internet connectivity, and interactive learning platforms, particularly in underserved rural and semi-urban areas where infrastructure gaps remain a barrier to blended learning adoption.

6.5 Continuous Professional Development and Monitoring:

Beyond initial teacher training, there should be structured and ongoing professional development programs focused on blended learning and data literacy. Regular classroom observations, performance evaluations, and feedback mechanisms should be institutionalized to monitor the effectiveness of these teaching strategies and support continuous improvement.

6.6S Alignment with National and International Education Goals:

The integration of blended learning and DDIS should be aligned with Nigeria's National Policy on Education, the Sustainable Development Goals (particularly SDG 4), and regional education commitments such as the African Union's Agenda 2063[32]. This alignment will ensure that educational innovations contribute meaningfully to long-term development objectives.

[32]Regha, Israel. (2017). Adoption of Blended Learning into the Nigerian Education System: Prospects and Challenges. People: International Journal of Social Sciences. 1. 129-142. 10.20319/pijss.2015.s21.129142.