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Enhancing Teacher Readiness, Professional Growth, And Pedagogical Adaptation In Online Education For Underserved Students In Delta Central Senatorial District

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ABSTRACT

This study aims to examine the role of professional development in enhancing teacher preparedness, fostering professional growth, and facilitating pedagogical adaptation for effective online education in underserved regions, specifically in Delta Central Senatorial District, Nigeria. The research investigates how professional development programmes support teachers in adapting to digital teaching methods and address the challenges faced by educators in resource-limited environments. A descriptive survey research design was employed, targeting secondary school teachers in Delta Central who had participated in online or blended learning since the COVID-19 pandemic. The study used a structured questionnaire to collect data on teachers preparedness, the effectiveness of professional development programmes, and the challenges teachers face in sustaining online education. The data were analyzed using descriptive statistics and inferential methods, including t-tests and Pearson correlation analysis. The study found that teachers in Delta Central were generally underprepared for online teaching, with professional development programmes being insufficiently tailored to their specific needs. While professional development had a modest impact on teacher preparedness and pedagogical adaptation, many teachers faced significant barriers such as inadequate infrastructure, limited access to digital tools, and a lack of ongoing support. Professional development programmes in Delta Central were found to be ineffective in fully preparing teachers for online education. The lack of targeted, context-specific training contributed to the continued challenges in digital teaching, particularly in underserved areas. The study recommends designing more tailored, continuous professional development programmes that focus on practical digital teaching skills and pedagogical innovation. Additionally, it emphasizes the need for improved infrastructure and institutional support to help teachers in resource-limited settings effectively implement online education. Policies should also be developed to ensure equitable access to digital tools and professional development opportunities for educators in underserved communities.

Keywords: Online Education, Teacher Preparedness, Professional Development, Pedagogical Adaptation, Underserved Students

INTRODUCTION

The rapid transition to online education, spurred by the COVID-19 pandemic, has highlighted critical gaps in access, teacher readiness, and the effectiveness of digital teaching methods, especially in

underserved communities. In Nigeria, the Delta Central Senatorial District offers a snapshot of these challenges, where many teachers were caught unprepared for the sudden shift to digital learning platforms. While online education provided a temporary solution to disruptions in traditional classroom settings, its long-term success relies heavily on the ability of teachers to adapt, innovate, and implement effective digital teaching strategies.

Professional development has become a crucial factor in equipping educators with the necessary skills and confidence to navigate the online teaching landscape (Trust & Whalen, 2020). For teachers serving marginalized communities, such as those in Delta Central, this training is not just beneficial—it is essential. However, effective teacher preparedness involves more than just mastering the technical aspects of online teaching; it requires adopting pedagogical approaches that engage diverse learners, promote equity, and create meaningful learning experiences in virtual environments (Hodges et al., 2020). In regions like Delta Central, where educational infrastructure is often lacking, the role of professional development programs tailored to the local context becomes even more critical. This study explores how professional development initiatives impact teacher preparedness and pedagogical transformations that support the sustainability of online education for underserved students in Delta Central. By examining the intersection of teacher training, technology, and teaching practices, the research aims to contribute to a more inclusive and responsive framework for online learning in Nigeria's underserved educational contexts.

Problem of the Study

The integration of online education in Nigeria has been uneven, with marked disparities in underserved regions like Delta Central Senatorial District. While digital learning has the potential to bridge educational gaps, many schools in this region lack the necessary infrastructure, resources, and trained personnel to offer quality online instruction. When the COVID-19 pandemic forced schools to shift to digital learning, most teachers were unprepared for the transition, and this challenge persists today (Daniel, 2020). This lack of readiness continues to affect the quality of education, especially for students in economically disadvantaged areas.

Professional development programs were introduced in response to the pandemic to help teachers improve their digital skills. However, the effectiveness and sustainability of these programs remain in question. Many of the initiatives have been generic, short-term, or poorly aligned with the unique challenges faced by teachers in resource-limited environments (Trust & Whalen, 2020). As a result, the pedagogical changes needed for meaningful online engagement have either been delayed or poorly executed. Moreover, there is a gap in research regarding how professional development affects both teacher preparedness and pedagogical change, specifically in underserved regions like Delta Central. The study seeks to address this gap by evaluating whether current professional development programs effectively equip teachers to support online learning in marginalized communities.

Purpose of the Study

The purpose of this study is to explore the role of professional development in shaping teacher preparedness and driving pedagogical shifts that enhance online education for underserved students in Delta Central Senatorial District, Nigeria. Following the sudden shift to digital learning, many teachers found themselves unprepared, particularly in marginalized areas where access to training and resources is limited (Hodges et al., 2020). This research aims to investigate how well current professional development programs prepare teachers to adopt digital tools and transform their teaching methods to meet the needs of students who have traditionally been excluded from the full benefits of education. The study focused on the intersection of teacher training, pedagogical change, and educational equity. By examining these factors, the research hopes to provide insights that can inform more inclusive and sustainable digital education models in underserved regions. The objectives of the study include:

1. Examining the level of teacher preparedness for online instruction in Delta Central, particularly among educators in underserved communities.
2. Assessing the accessibility and effectiveness of professional development programs designed to enhance teachers' ability to deliver online education.

3. Investigating how professional development initiatives have influenced teachers' adoption of new pedagogical approaches.
4. Identifying the key challenges teachers face in sustaining online education and the role of professional development in overcoming these challenges.

Research Questions

1. What is the level of teacher preparedness for online instruction in Delta Central Senatorial District?
2. How accessible and effective are the professional development programs available to teachers for online education?
3. To what extent have pedagogical shifts occurred among teachers following exposure to professional development initiatives?
4. What challenges do teachers face in sustaining online education, and how does professional development help address these challenges?

Hypotheses

H₀₁: There is no significant difference in teacher preparedness for online instruction based on the type of school.

H₀₂: There is no significant difference in teacher preparedness for online instruction based on the school's location.

H₀₃: There is no significant relationship between professional development and teacher preparedness for online teaching.

H₀₄: There is no significant relationship between professional development and pedagogical shifts in online education.

Significance of the Study

This study holds significance for several key reasons, particularly as the demand for equitable access to quality online education in Nigeria continues to grow. First, it contributes to the ongoing conversation about teacher preparedness by examining how professional development initiatives shape teachers' ability to effectively deliver online education in underserved regions. In areas like Delta Central, where socio-economic barriers and infrastructural limitations intersect, the study provides valuable insights into the challenges teachers face and the kinds of support they need to succeed. For policymakers and education planners, the study provides evidence that can inform the design of more targeted, inclusive professional development programs. It highlights the importance of context-specific training models that not only equip teachers with digital skills but also foster pedagogical innovation. For school administrators and teacher training institutions, the study offers practical recommendations for supporting teachers in adopting learner-centered, interactive, and adaptable teaching practices. For the academic community, the study enriches the body of knowledge on digital learning and educational equity by focusing on a region that is often overlooked in global studies. It provides localized data that can be used for comparative analysis with other underserved regions in Nigeria and Sub-Saharan Africa. Ultimately, the study advocates for a more inclusive and equitable approach to online education, with a strong emphasis on the importance of teacher development.

Scope and Delimitation of the Study

This study focuses on the role of professional development in enhancing teacher preparedness and driving pedagogical shifts that support the effective delivery of online education in underserved communities within Delta Central Senatorial District, Nigeria. The research is limited to public and private secondary schools in the district that have engaged in some form of online education since the COVID-19 pandemic. The study will target teachers who have participated in professional development programs focused on online or blended learning. It will explore their level of preparedness, the types of training they have received, and how these programs have influenced their teaching practices. School administrators and key stakeholders may also be included to provide insights into institutional support and policy implementation.

Delimitations of the study include the focus on Delta Central alone, which may limit the generalizability of findings to other regions in Nigeria. The study will concentrate on professional development as the primary factor influencing teacher preparedness and pedagogical shifts, without delving deeply into other

potential factors like student engagement, parental involvement, or infrastructure quality. Additionally, the study will focus on the post-COVID-19 era and will not extensively cover traditional face-to-face teaching unless it relates to the transition to or integration with online learning models. By narrowing its focus, the study aims to provide a detailed understanding of how targeted professional development can support sustainable online education in underserved regions like Delta Central.

Literature Review

Theoretical Framework

The shift to online education, which was significantly accelerated by the COVID-19 pandemic, has brought new challenges and opportunities for educators, particularly in underserved regions. This literature review explores the critical role that professional development plays in helping teachers adapt to and thrive in online learning environments. The review begins by discussing how professional development supports teachers in improving their digital skills and instructional confidence. It then explores the broader concept of teacher preparedness, looking at the necessary skills, mindset, and support systems required for effective online teaching. We also examine the pedagogical shifts required for successful online education, focusing on the need for innovative, inclusive, and student-centered teaching approaches. Lastly, we address the ongoing challenge of educational inequity in underserved communities, particularly in places like the Delta Central Senatorial District, where socio-economic and infrastructural barriers make access to effective digital education a challenge. These thematic areas provide a foundation for understanding the complexities of online education in marginalized areas and highlight the importance of targeted, context-sensitive professional development programs. This study draws on two complementary theories: the Technological Pedagogical Content Knowledge (TPACK) framework and Transformative Learning Theory (TLT). These frameworks offer valuable perspectives on how professional development influences both teacher preparedness and the pedagogical shifts necessary for successful online education in underserved contexts like Delta Central.

1. Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework, introduced by Mishra and Koehler (2006), builds on Shulman's (1986) concept of Pedagogical Content Knowledge by adding a critical third dimension: technology. TPACK emphasizes that effective teaching with technology requires a dynamic relationship between three areas of knowledge: content (the subject matter), pedagogy (the methods used to teach), and technology (the digital tools and platforms used in instruction). In the context of this study, TPACK will be used to examine how well professional development equips teachers with the necessary skills to integrate technology meaningfully into their teaching practices. The framework will help assess how teachers in underserved communities are able to design and deliver online instruction that is both pedagogically sound and technologically effective. As Trust and Whalen (2020) argue, strengthening all three areas of knowledge through professional development can lead to better outcomes in online teaching.

2. Transformative Learning Theory (TLT)

Jack Mezirow's (1997) Transformative Learning Theory offers another lens through which to understand how professional development can shift teachers' perspectives and teaching practices. TLT suggests that learning happens when individuals critically reflect on their existing beliefs, leading to a transformation in their attitudes, actions, and overall worldview. In this study, professional development is seen as a catalyst for transformative learning, encouraging teachers to move away from traditional, face-to-face teaching methods and adopt new pedagogical strategies suited to online environments. This theory is particularly relevant for educators in underserved regions, where conventional methods have been entrenched and teachers may be less familiar with digital tools. By engaging in professional development, teachers have the opportunity to rethink and reshape their approaches to teaching, especially in a digital context. As Baran and AlZoubi (2020) highlight, professional learning that encourages reflection, collaboration, and experimentation is crucial for sustaining long-term pedagogical change in technology-rich environments. The TPACK and Transformative Learning Theory frameworks together provide a robust basis for exploring the impact of professional development on teacher preparedness and pedagogical innovation in online education for underserved students.

3. Professional Development and Online Teaching Competence

Professional development is widely recognized as a key factor in improving teachers' knowledge, skills, and attitudes toward effective online teaching. According to Trust and Whalen (2020), educators who engage in structured, ongoing professional development are more likely to demonstrate competence in using digital tools, awareness of digital pedagogy, and the flexibility to adapt their teaching strategies for online platforms. However, the success of such programs depends heavily on their relevance, accessibility, and alignment with local educational contexts. In many regions of Nigeria, including Delta Central, professional development initiatives often face challenges such as inadequate funding, inconsistent delivery, and a one-size-fits-all approach (Akinrinade & Bello, 2022). Consequently, many teachers are ill-prepared for the transition from traditional classroom teaching to online instruction, especially in underserved communities where digital infrastructure is scarce.

4. Teacher Preparedness for Online Education

Teacher preparedness for online education is a multifaceted concept that includes not only technical readiness but also the skills necessary for designing effective online learning experiences, managing virtual classrooms, and engaging diverse learners online (Rapanta et al., 2020). Research has shown that rapid shifts to remote teaching, like the one caused by the COVID-19 pandemic, exposed significant gaps in teacher readiness around the world (Hodges et al., 2020). In Nigeria, these gaps were particularly pronounced in rural and underserved areas, where access to the internet, digital devices, and ICT support is limited or non-existent (Olasile et al., 2022). Preparedness goes beyond just having access to the necessary tools—it also involves being mentally and professionally equipped to use those tools effectively. Without targeted professional development and ongoing support, many teachers struggle to deliver high-quality online instruction, especially to marginalized students who may already face barriers to learning.

5. Pedagogical Shifts in Online and Blended Learning

The transition from traditional to online learning is not just about adapting to new technology; it also requires significant changes in pedagogy. Effective online education emphasizes learner autonomy, interactive activities, multimodal content delivery, and formative assessment (Martin et al., 2020). However, many teachers in developing countries have yet to make these pedagogical shifts due to limited exposure to innovative teaching methods and a lack of continued professional development. These shifts also involve adopting inclusive strategies that can support students with varying levels of digital literacy and learning needs, especially in underserved communities. When professional development programs focus on equity and pedagogical transformation, they can significantly improve the quality of teaching and learning in online environments (Baran & AlZoubi, 2020).

6. Online Education and Educational Inequity in Underserved Communities

While online education holds the potential to bridge educational gaps, its effectiveness depends largely on how it is implemented. In underserved regions of Nigeria, including Delta Central, systemic inequities in infrastructure, teacher training, and student support continue to impede the success of digital learning (Okoye & Nwajiuba, 2021). These challenges are particularly pronounced in areas where both students and teachers often lack access to reliable internet, digital devices, and digital literacy training. Without intentional efforts to address these disparities through well-designed, context-sensitive interventions, including professional development programs, online education may deepen the educational divide, further marginalizing students who are already disadvantaged in the traditional system (Daniel, 2020).

RESEARCH METHODOLOGY

This section describes the research design, population, sampling procedures, data collection instruments, validation and reliability processes, and methods of data analysis adopted for this study. The purpose is to systematically examine how professional development influences teacher preparedness and pedagogical shifts in online education delivery within underserved communities of Delta Central Senatorial District, Nigeria.

Research Design

The study adopted a descriptive survey research design, which is appropriate for collecting data from a large population to explore existing conditions, relationships, and perceptions among variables. Creswell and Creswell (2018), noted that, a descriptive survey allows researchers to gather factual information about prevailing practices, beliefs, and opinions to describe and interpret educational phenomena. This design was considered suitable because it facilitated the collection of quantitative data on teachers' exposure to professional development programs, their level of preparedness for online instruction, and the nature of pedagogical adaptations in digital learning contexts.

Population and Sample

The target population for the study comprised secondary school teachers in both public and private schools across the Delta Central Senatorial District, particularly those who had participated in online or blended teaching since the COVID-19 pandemic. To ensure representativeness, a stratified random sampling technique was employed. The strata were based on school type (public/private) and location (urban/rural). From the stratified groups, a total sample of 200 teachers was selected from various local government areas within the senatorial district. This sample size was deemed adequate for a population of this nature and aligns with recommendations by Krejcie and Morgan (1970) for determining representative samples in educational research.

Instrument for Data Collection

The primary data collection tool was a researcher-developed structured questionnaire titled - *Professional Development and Online Pedagogical Adaptation Questionnaire (PDO-PAQ)*. The instrument was designed to obtain quantitative data from teachers involved in online or blended learning in Delta Central Senatorial District. It consisted of five sections (A–E) organized to address the study objectives comprehensively:

Section A: Demographic Information – This section collected respondents' background data such as gender, age, years of teaching experience, school type, school location, and exposure to professional development programs.

Section B: Exposure to Professional Development – Contained five items assessing the frequency, quality, mode of delivery, and perceived usefulness of professional development programs on online education.

Section C: Teacher Preparedness for Online Instruction – Included five items evaluating teachers' confidence and competence in lesson planning, assessment, classroom management, and use of digital tools for online instruction.

Section D: Pedagogical Shifts and Online Teaching Practice – Examined changes in teaching approaches due to professional development, including the use of interactive platforms, learner-centered strategies, differentiated instruction, and multimedia resources.

Section E: Challenges and Institutional Support – Focused on barriers such as poor internet connectivity, limited student access to devices, workload, and institutional support structures.

The instrument used a 4-point Likert scale:

1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*.

This scale excluded a neutral midpoint to encourage respondents to take a definitive stance, enhancing data precision and interpretability.

Validity of the Instrument

The instrument underwent content validation by three academic experts from the Department of Educational Measurement and Evaluation. The experts evaluated the questionnaire items for clarity, relevance, and alignment with the study objectives. Their suggestions led to refinements in wording and item organization to enhance contextual appropriateness and construct representation.

Reliability of the Instrument

To determine reliability, a pilot study was conducted using 20 teachers from secondary schools outside the study area but with similar characteristics. Responses were analyzed using the Cronbach's Alpha coefficient, which yielded an overall reliability index of 0.82, signifying high internal consistency. Each

subscale also recorded reliability coefficients above 0.70, meeting the benchmark recommended by Taber (2018) for social science research instruments.

Method of Data Collection

Data collection was carried out by the researcher and two trained assistants. The questionnaires were distributed physically to selected schools across both urban and rural areas within the district. Prior permission was obtained from school administrators and the Delta State Ministry of Education. Respondents were informed of the study’s purpose, assured of anonymity and confidentiality, and encouraged to respond honestly. The data collection process spanned four weeks, ensuring comprehensive coverage and high retrieval rates.

Method of Data Analysis

Collected data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to answer the research questions. To test the null hypotheses, inferential statistical methods including independent samples t-tests and Pearson Product-Moment Correlation (PPMC) were employed. All hypotheses were tested at a 0.05 level of significance. These analyses provided empirical insights into the relationship between professional development exposure, teacher preparedness, and pedagogical shifts in online teaching within underserved communities.

PRESENTATION OF RESULTS

This section presents the findings of the study based on the analysis of data collected from 200 respondents across schools in Delta Central Senatorial District. The results are organized around the four research questions and four hypotheses that guided the investigation. Descriptive statistics are provided to highlight patterns in teacher preparedness, access to and effectiveness of professional development, pedagogical shifts, and challenges encountered in sustaining online education. Inferential statistics, including t-tests and Pearson correlations, are used to test the stated null hypotheses and establish relationships or differences among variables. Each result is accompanied by appropriate Tables and an interpretation to provide clarity and insight into the data.

Research Question 1: *What is the level of teacher preparedness for online instruction in Delta Central Senatorial District?*

Table 1: Descriptive Statistics on Teacher Preparedness for Online Instruction

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Teacher_Preparedness	200	1.20	2.40	1.7810	0.35619
Professional_Development	200	1.00	2.80	1.8400	0.49154
Pedagogical_Shifts	200	1.00	3.00	1.7320	0.41887
Challenges	200	1.00	3.00	1.7460	0.45577
Valid N (listwise)	200				

Result in Table 1 shows the descriptive statistics of teacher preparedness for online instruction in Delta Central Senatorial District, which indicated that the level of teacher preparedness for online instruction was low, with a mean score of 1.78 (SD = 0.36) on a 4-point Likert scale. This suggests that, on average, teachers expressed minimal confidence in their ability to manage various aspects of online teaching. The narrow standard deviation also indicates low variability in responses across the sampled population.

Research Question 2: *How accessible and effective are the professional development programmes available to teachers for online education?*

The findings as presented in Table1 above also show that teachers rated professional development (PD) programmes moderately low in terms of accessibility and effectiveness. The mean score was 1.84 (SD = 0.49), implying that while PD programs were somewhat available, they may not have sufficiently addressed teachers’ practical needs for online instruction. The relatively higher standard deviation reflects more varied responses among the participants.

Research Question 3: *To what extent have pedagogical shifts occurred among teachers following exposure to professional development initiatives?*

Results in Table 1 further revealed limited evidence of significant pedagogical shifts among teachers who participated in PD. The mean score for pedagogical shifts was 1.73 (SD = 0.42), indicating a modest adoption of new instructional strategies and digital tools. This suggests that while some transformation may have occurred, the changes were neither deep nor widespread.

Research Question 4: *What challenges do teachers face in sustaining online education, and how does professional development help address these challenges?*

Results in Table 1 also revealed a mean score of 1.75 (SD = 0.46), the data suggest that teachers encountered substantial challenges in sustaining online education, particularly in underserved areas. These challenges likely included poor infrastructure, limited access to student devices, and insufficient administrative support. While PD was somewhat helpful, its impact was constrained by broader systemic issue

In Overall, the descriptive results suggest that teachers in Delta Central Senatorial District are not adequately prepared for online instruction. PD programmes have not sufficiently driven meaningful pedagogical shifts or fully addressed the ongoing challenges in online teaching, particularly in underserved contexts.

Hypothesis 1 (H₀₁)

There is no significant difference in teacher preparedness for online instruction based on the type of school.

Table 2:Independent Samples Test on Teacher Preparedness for Online Instruction Based on School Type

VARIABLE	SCHOOL TYPE	N	Mean	Std. Deviation	T-test	P-value
Teacher_ Preparedness	Public	100	1.778	.35720	-	0.906
	Private	100	1.784	.35696	0.119	

****.** Level of significant at the 0.05 level (2-tailed), Df = 198

An independent samples t-test was conducted to compare teacher preparedness between public and private schools as presented in Table 2. Results showed no significant difference between public school teachers (M = 1.78, SD = 0.36) and private school teachers (M = 1.78, SD = 0.36); t(198) = -0.12, p = .906. Thus, H₀₁ is not rejected, indicating that school type does not significantly influence teacher preparedness for online instruction.

Hypothesis 2 (H₀₂)

There is no significant difference in teacher preparedness for online instruction based on the school's location.

Table 3: Independent Samples Test on Teacher Preparedness for Online Instruction Based on School Location

VARIABLE	School Location	N	Mean	Std. Deviation	T-test	P-value
Teacher_ Preparedness	Urban	100	1.678	0.3472	-0.117	0.801
	Rural	100	1.684	0.3470		

****.** Level of significant at the 0.05 level (2-tailed), Df = 198

A second independent samples t-test compared preparedness between urban and rural teachers, presented in Table 3. Again, results revealed no significant difference in teacher preparedness between urban (M = 1.68, SD = 0.35) and rural (M = 1.68, SD = 0.35) locations; t(198) = -0.12, p = .801. Therefore, H₀₂ is not rejected, suggesting that location (urban or rural) does not significantly affect teachers' online preparedness.

Hypothesis 3 (H₀₃): There is no significant relationship between professional development and teacher preparedness for online teaching.

Table 4: Pearson Correlation Between Professional Development and Teacher Preparedness

		Teacher_Preparedness	Professional_Development
Teacher_Preparedness	Pearson Correlation	1	.198**
	Sig. (2-tailed)		.005
	N	200	200
Professional_Development	Pearson Correlation	.198**	1
	Sig. (2-tailed)	.005	
	N	200	200

****.** Correlation is significant at the 0.01 level (2-tailed)

A Pearson correlation was calculated to examine the relationship between professional development and teacher preparedness. The results in Table 4, showed a statistically significant but weak positive correlation between the two variables, $r(200) = .198$, $p = .005$. Because the p-value is less than .05, H₀₃ is rejected. This implies that professional development is positively associated with teacher preparedness for online instruction, though the effect size is modest.

Hypothesis 4 (H₀₄)

There is no significant relationship between professional development and pedagogical shifts in online education

Table 5: Pearson Correlation Between Professional Development and Pedagogical Shifts

		Professional_Development	Pedagogical_Shifts
Professional_Development	Pearson Correlation	1	.251**
	Sig. (2-tailed)		.000
	N	200	200
Pedagogical_Shifts	Pearson Correlation	.251**	1
	Sig. (2-tailed)	.000	
	N	200	200

****.** Correlation is significant at the 0.01 level (2-tailed).

Another Pearson correlation was used to examine the association between professional development and pedagogical shifts. The results in Table 5 revealed a moderate positive correlation, $r(200) = .251$, $p < .001$. Since this is statistically significant, H₀₄ is also rejected. This means that increased professional development is associated with greater shifts in teaching practices among teachers.

Conclusively, No significant differences were found in teacher preparedness based on school type or location. However, professional development was significantly related to both teacher preparedness and pedagogical changes, underscoring its critical role in enhancing online instructional practices.

DISCUSSION

The findings of this study offer critical insights into the state of teacher readiness for sustaining online education in underserved communities within Delta Central Senatorial District, Nigeria. Overall, the low mean scores recorded across domains such as teacher preparedness, professional development, pedagogical adaptation, and institutional support reveal the deep-rooted challenges teachers face in transitioning to and maintaining effective digital learning environments.

The results from the first two research questions indicate that teachers demonstrated only moderate levels of preparedness for online instruction, while professional development (PD) opportunities were limited in

both scope and effectiveness. This finding corroborates previous studies which suggest that, although digital learning tools are increasingly available, many teachers lack the necessary pedagogical and technological competencies to integrate them effectively into their instructional practices (Ogunode et al., 2022; Oboh & Akpan, 2021).

Interestingly, the analysis of hypotheses revealed no statistically significant differences in teacher preparedness based on school type (public or private) or geographical location (urban or rural). This suggests that deficiencies in online teaching readiness are widespread and not confined to specific educational contexts. Contrary to expectations that teachers in urban or private institutions might exhibit greater technological competence, the results point toward a pervasive structural issue linked to inadequate teacher training and insufficient implementation of educational technology policies.

However, the study established significant positive correlations between professional development and both teacher preparedness and pedagogical shifts. This finding highlights the central role of continuous, relevant, and context-driven professional development in enhancing teachers' ability to adapt to digital modes of instruction. Teachers who participate in sustained and practical PD programs tend to exhibit greater confidence and creativity in employing learner-centered and technology-supported instructional strategies. This aligns with the findings of Adebayo and Abdulrahman (2020), who emphasized that consistent, well-designed professional development fosters both competence and innovation in teaching practices.

Ultimately, the discussion underscores that the sustainability of online education in underserved communities depends not merely on technology provision but on the quality and consistency of teacher capacity-building initiatives.

CONCLUSION

The study concludes that while teachers in Delta Central Senatorial District have begun to engage with online teaching practices, their overall preparedness remains insufficient for sustaining effective digital instruction. Although professional development programs exist, they are often irregular, theoretical, or poorly aligned with the realities of teachers working in resource-limited environments. The persistence of infrastructural gaps, inequitable access to ICT facilities, and weak institutional support further constrains the growth of online education in these communities.

Nevertheless, the study confirms a clear and positive link between meaningful professional development and improvements in both teacher preparedness and pedagogical transformation. This suggests that enhancing the relevance, accessibility, and quality of PD programs can serve as a catalyst for strengthening teachers' digital competence and instructional effectiveness. Sustained policy interventions and institutional reforms are therefore essential to build a resilient, inclusive, and technology-driven educational system.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations are proposed:

1 . Strengthen Professional Development Programs:

Governments and educational agencies should design and implement practical, context-specific professional development initiatives focusing on online pedagogy, digital literacy, and adaptive instructional practices. Such programs should be continuous rather than ad hoc.

2 . Establish ICT Support Structures:

Professional training should be complemented with technical support systems such as mentorship programs, help desks, and peer-learning networks to assist teachers in overcoming day-to-day digital instructional challenges.

3 . Promote Equitable Access to ICT Infrastructure:

Policymakers must address the digital divide by providing reliable internet access, affordable digital devices, and power supply to schools in underserved areas, ensuring that all teachers and students can fully participate in online learning.

4 . Integrate Online Pedagogy into Teacher Education Curricula:

Teacher training institutions and colleges of education should revise their curricula to include online instructional design, digital assessment strategies, and technology-enabled learner engagement methods as core components of teacher preparation.

5 . Institutionalize Monitoring and Evaluation of Professional Development:

Continuous monitoring and evaluation mechanisms should be embedded within teacher appraisal systems to track the impact of PD programs and to ensure that outcomes align with evolving digital learning needs.

Availability of Data and Materials

The datasets generated and/or analyzed in this current study are not publicly available due to participant confidentiality and institutional data protection policies, but they are available from the corresponding author upon reasonable request.

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