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Education and Digital Inclusion in Sub-Saharan Africa: Evidence from Nigeria in Bridging Regional Inequalities

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Abstract

Digital transformation has become a defining feature of twenty-first century economic and social development. Access to digital infrastructure, digital skills, and technology-enabled learning environments increasingly determines participation in labour markets, innovation systems, and civic life. Despite global advances in connectivity, Sub-Saharan Africa continues to experience some of the widest digital inequalities worldwide. Within the region, disparities in educational infrastructure, teacher digital competence, and socio-economic conditions shape uneven patterns of digital inclusion. This study investigates the educational determinants of digital inclusion in Nigeria, situating the analysis within broader Sub-Saharan African digital trends. Using a quantitative research design, data were collected from a Cochran-determined sample of 384 respondents across three geopolitical regions through a multistage sampling procedure. Descriptive statistics, one-way ANOVA, multiple regression analysis, and mediation modelling were employed to examine regional disparities and the predictive role of educational variables. Findings reveal statistically significant regional differences in digital inclusion, with the South-West recording the highest digital inclusion scores and the Northern region the lowest. Teacher digital competence emerged as the strongest predictor of digital inclusion, followed by ICT resource availability and device ownership. Mediation analysis confirmed that teacher competence significantly mediates the relationship between regional location and digital inclusion. Socio-economic status was not a statistically significant predictor once educational variables were included in the model. The study concludes that bridging regional digital inequalities requires sustained investment in teacher professional development, school ICT infrastructure, reliable electricity, and digital curriculum integration. Policy interventions must prioritise human capital development and regionally targeted digital equity strategies to promote inclusive digital transformation across Nigeria and Sub-Saharan Africa.

Keywords: Digital inclusion; ICT in education; regional inequality; teacher digital competence; Nigeria; Sub-Saharan Africa; digital divide; educational technology.

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1. INTRODUCTION

Digital technologies are reshaping global economic systems, educational structures, and social interactions. The rapid diffusion of broadband connectivity, mobile technologies, cloud computing, artificial intelligence, and digital platforms has transformed the nature of work, governance, and knowledge production. Countries with advanced digital infrastructure and robust digital skills ecosystems experience enhanced productivity, innovation, and competitiveness (OECD, 2019; World Bank, 2021).

Digital inclusion refers to equitable access to digital technologies, connectivity, digital literacy, and the capacity to use digital tools effectively for economic, educational, and social advancement. In contemporary economies, digital inclusion has become inseparable from human capital development. Populations lacking digital access or digital skills face increasing risks of labour market exclusion, reduced educational opportunities, and social marginalisation (UNESCO, 2021).

While global internet penetration continues to rise, digital transformation remains highly uneven. Sub-Saharan Africa (SSA) remains the least digitally connected region globally. According to the International Telecommunication Union (2024), internet usage rates in Africa remain significantly below the global average. Mobile internet penetration, although

expanding, is constrained by affordability barriers, limited digital literacy, and inadequate infrastructure (GSMA, 2024).

Beyond connectivity gaps, digital inequality increasingly reflects disparities in skills and meaningful usage. Access to devices alone does not guarantee digital participation. Schools, teachers, and educational systems play a pivotal role in shaping digital capability. Where teacher competence, ICT infrastructure, and curriculum integration are weak, digital technologies fail to translate into inclusive development (UNESCO, 2023).

Nigeria provides a compelling case study within the Sub-Saharan African context. As Africa's largest economy and one of its most dynamic digital markets, Nigeria has experienced rapid growth in mobile subscriptions, fintech innovation, and ICT sector contribution to GDP (National Bureau of Statistics, 2024). However, substantial regional disparities persist in infrastructure, teacher capacity, electricity supply, and socio-economic conditions.

Historically rooted educational inequalities between Northern and Southern Nigeria continue to influence digital readiness. Regions with stronger educational infrastructure and institutional capacity demonstrate higher digital competence and digital inclusion, while regions with structural disadvantages remain digitally marginalised.

This study seeks to address three central research questions:

- Are there statistically significant regional differences in digital inclusion in Nigeria?
- To what extent do educational factors predict digital inclusion?
- Does teacher digital competence mediate the relationship between region and digital inclusion?

2. LITERATURE REVIEW

2.1 Conceptualising Digital Inclusion and the Digital Divide

The concept of the digital divide has evolved significantly over the past two decades. Early scholarship conceptualised the digital divide primarily as a binary distinction between those with and without access to internet connectivity. However, contemporary research recognises that digital inequality is multidimensional, encompassing disparities in infrastructure, device ownership, digital skills, and meaningful usage (OECD, 2019; UNESCO, 2021).

Digital inclusion extends beyond physical connectivity to incorporate the capacity to use digital technologies effectively for learning, economic participation, civic engagement, and innovation. According to UNESCO (2021), digital inclusion requires three interrelated components: (1) access to infrastructure and devices, (2) digital literacy and skills, and (3) supportive institutional and policy environments.

Recent global analyses emphasise the transition from the "first-level digital divide" (access gaps) to the "second-level digital divide" (skills and usage gaps). Even in contexts where connectivity exists, differences in digital competence and institutional capacity result in unequal outcomes (World Bank, 2021). Thus, education systems are central to bridging not only access disparities but also skills-based inequalities.

2.2 Digitalisation, Human Capital, and Economic Development

Digital transformation is increasingly recognised as a key driver of economic growth. Investments in broadband infrastructure, ICT innovation, and digital skills have been associated with improved labour productivity and economic diversification (OECD, 2019). The World Bank (2021) argues that digital economies expand employment opportunities, reduce transaction costs, and facilitate access to markets and financial services.

However, the economic benefits of digitalisation depend heavily on human capital development. Digital infrastructure without digital skills yields limited productivity gains. Education systems therefore function as the primary institutional mechanism for preparing digitally competent citizens capable of participating in technology-driven economies (UNESCO, 2023).

Empirical evidence suggests that countries with strong ICT-integrated education systems demonstrate higher digital readiness and innovation capacity. Conversely, weak educational infrastructure limits the developmental impact of digital investments (World Bank, 2021).

2.3 Digital Education and Teacher Competence

Teacher digital competence has emerged as one of the most critical determinants of effective ICT integration in education. While infrastructure investments often receive policy attention, evidence indicates that teacher capability significantly influences whether digital tools translate into improved learning outcomes (UNESCO, 2023).

Teacher digital competence encompasses:

- Technical skills (basic ICT operation),
- Pedagogical integration skills (using technology to enhance instruction),
- Digital assessment literacy,
- Ethical and safe use of digital tools.

UNESCO (2023) emphasises that teacher professional development must move beyond basic computer literacy to incorporate technology-enhanced

pedagogy. Without adequate training, digital tools remain underutilised or misapplied.

In low-income contexts, disparities in teacher training opportunities contribute to uneven digital readiness. Regions with stronger teacher development programmes often demonstrate higher levels of digital integration, even when infrastructure is comparable.

Africa's Digital Landscape

Sub-Saharan Africa remains the least digitally connected region globally. According to the International Telecommunication Union (2024), internet penetration in Africa remains significantly below global averages. While mobile network coverage has expanded, usage remains constrained by affordability barriers and limited digital literacy (GSMA, 2024).

The Alliance for Affordable Internet (2023) reports that in several African countries, mobile data costs exceed internationally recommended affordability thresholds. Affordability challenges disproportionately affect low-income households and rural communities.

Electricity deficits compound connectivity limitations. The World Bank (2024) estimates that a substantial proportion of Sub-Saharan Africa's population lacks reliable electricity, undermining the functionality of digital learning initiatives in schools.

Educational infrastructure remains uneven across the region. UNICEF (2023) reports that many schools lack functional computer laboratories, stable internet connectivity, or reliable power supply. Consequently, digital access remains highly stratified along urban–rural and socio-economic lines.

2.5 Regional Inequalities in Nigeria

Nigeria represents both opportunity and inequality within Africa's digital transformation landscape. The ICT sector contributes significantly to national GDP and has experienced rapid expansion (National Bureau of Statistics, 2024). The Nigerian Communications Commission (2024) reports substantial internet subscription growth in recent years.

However, national averages mask significant regional disparities. Southern states, particularly in the South-West, exhibit stronger ICT infrastructure, higher broadband penetration, and greater institutional capacity. In contrast, Northern regions face structural challenges including:

- Limited broadband coverage,
- Electricity shortages,
- Lower educational attainment levels,
- Security-related school disruptions.

The World Bank (2021) highlights that regional infrastructure gaps directly influence digital adoption patterns in Nigeria. Regions with weaker public investment and institutional capacity demonstrate slower digital uptake.

These disparities extend to the education sector. Variations in school infrastructure, teacher training opportunities, and device availability contribute to uneven digital inclusion outcomes.

Theoretical Framework

This study is anchored in a human capital development perspective, which posits that investments in education and skills enhance productivity, innovation, and economic participation. Within this framework, digital competence is conceptualised as a form of modern human capital necessary for participation in digital economies.

Additionally, the study adopts a structural inequality perspective, recognising those regional disparities in infrastructure and institutional capacity shape unequal access to opportunities. Regional location is therefore conceptualised not merely as geography but as an indicator of structural resource distribution.

The conceptual model guiding this study proposes that:

- Region influences educational infrastructure and teacher competence.
- Educational variables influence digital inclusion.
- Teacher digital competence mediates the relationship between region and digital inclusion.

This framework integrates structural and human capital perspectives to explain digital inequality within a lower-middle-income country context.

2.7 Research Hypotheses

Based on the literature, the study tests the following hypotheses:

H1: There are significant regional differences in digital inclusion.

H2: Teacher digital competence significantly predicts digital inclusion.

H3: ICT resource availability significantly predicts digital inclusion.

H4: Device ownership significantly predicts digital inclusion.

H5: Teacher digital competence mediates the relationship between region and digital inclusion.

3. METHODOLOGY

3.1 Research Design

This study adopted a quantitative cross-sectional research design to examine the influence of educational factors on digital inclusion across selected regions in Nigeria. A cross-sectional design was considered appropriate because it allows for the examination of relationships among variables within a defined population at a specific point in time.

The design enables statistical testing of group differences (ANOVA), predictive relationships (multiple regression), and indirect effects (mediation analysis). Although longitudinal designs provide stronger causal inference, cross-sectional modelling is widely used in digital divide research where the objective is to identify structural predictors and disparities (World Bank, 2021).

Population and Sample Size Determination

The target population comprised individuals across selected Nigerian geopolitical zones with exposure to educational environments where digital tools are utilised. Given the absence of a precise sampling frame and the large, indeterminate population size, the sample size was determined using Cochran's (1963) formula for estimating sample size in large populations.

The formula is expressed as:

$$n = \frac{[Z]2\ (pq)}{e2}$$

$$n = \frac{[Z]2(P)(1-P)}{e2}$$

Where:

n = sample size

Z = Z-value (standard normal deviate) at 95% confidence level = 1.96

p = estimated proportion of the population (0.5)

q = 1 – p = (0.5)

e = desired level of precision or margin of error = 0.05

Therefore;

$$n = \frac{[1.96]2(0.5)(1-0.5)}{0.042}$$

$$n = \frac{3.8416\ (0.25)}{0.0025}$$

n = 384.16

= 384

Sampling Procedure

A multistage sampling technique was employed to ensure representativeness across regions. In the first stage, three geopolitical zones were randomly selected from Nigeria's six zones. In the second stage, two states were randomly chosen from each of the selected zones, resulting in a total of six states. The third stage involved stratified random sampling within each state to select respondents based on educational and socio-demographic characteristics. Finally, approximately 64 respondents were selected from each state to achieve a total sample size of 384. This multistage approach ensured regional diversity while maintaining statistical balance across the study groups.

Variables and Measurement

The study's dependent variable, the Digital Inclusion Index (DII), was measured using a composite index ranging from 0 to 100. This index incorporated multiple dimensions, including internet access frequency, device ownership, ICT usage in education, self-assessed digital skills, and access to ICT facilities. Scores were standardised and aggregated to form a continuous index, with higher scores indicating greater levels of digital inclusion.

The independent variables included Teacher Digital Competence (TDC), ICT Resource Availability, Device Ownership, Socio-Economic Status (SES), School Type, and Region. Teacher Digital Competence was measured on a 5-point Likert scale (1 = Very Low, 5 = Very High) and assessed teachers perceived ability to use digital tools, integrate ICT into teaching, conduct digital assessments, and facilitate online learning. ICT Resource Availability was also measured on a 5-point Likert scale, evaluating the presence of computer labs, internet connectivity in schools, projectors and smart boards, and functional ICT infrastructure. Device Ownership captured the number of personal digital devices owned by respondents, ranging from 0 to 3. Socio-Economic Status was measured using income proxies and asset indicators combined into a Likert composite scale. School Type was dummy coded (0 = Public, 1 = Private), and Region was treated as a categorical variable, comprising South-West, South-East, and North.

Instrument for Data Collection

Data were collected using a structured questionnaire organised into four sections. Section A captured respondents' demographic information, while Section B focused on ICT access and device ownership. Section C assessed teacher digital competence, and Section D examined digital usage and inclusion indicators. Prior to the main data collection, the questionnaire was pilot-tested with 30 respondents drawn from outside the study sample to ensure clarity, reliability, and suitability of the instrument.

Reliability and Validity

Internal consistency reliability was assessed using Cronbach's alpha:

Scale	Cronbach's α
Teacher Digital Competence	0.87
ICT Resource Availability	0.82
Digital Inclusion Index	0.89

All values exceeded the recommended threshold of 0.70, indicating strong internal consistency.

Content validity was ensured through expert review by specialists in educational technology and digital policy, who assessed the relevance and adequacy of the instrument items. Construct validity was supported by the consistency of the factor structure observed during the pilot analysis, indicating that the items appropriately measured the intended constructs. In addition, face validity was verified during the pretesting stage, confirming that the instrument appeared clear, appropriate, and understandable to the target respondents.

Data Collection Procedure and Analysis

Data were collected over a six-week period through the administration of questionnaires in selected schools and educational institutions by trained research assistants. Participation in the study was voluntary, and informed consent was obtained from all respondents prior to data collection. The collected data were analysed using statistical software, employing a range of analytical techniques. These included descriptive statistics, such as means and standard deviations, to summarise the data; one-way analysis of variance (ANOVA) to examine regional differences; multiple regression analysis to identify the key predictors of digital inclusion; and in addition to the Sobel test, mediation effects were further examined using a non-parametric bootstrapping procedure with 5,000 resamples, as recommended by contemporary mediation analysis literature. Bootstrapping generates bias-corrected confidence intervals for the indirect effect without assuming normality of the sampling distribution, thereby providing a more robust and statistically reliable estimate of mediation effects. An indirect effect is considered statistically significant when the 95% confidence interval does not include zero.

RESULTS

This section presents the empirical findings of the study in line with the stated research questions and hypotheses. The analysis proceeds in four stages. First, descriptive statistics are presented to illustrate regional patterns in digital inclusion and the key educational variables. Second, a one-way analysis of variance (ANOVA) is conducted to test whether statistically significant regional differences exist in digital inclusion. Third, multiple regression analysis is employed to identify the relative contribution of educational predictors to digital inclusion. Finally, mediation analysis is conducted to examine whether teacher digital competence mediates the relationship between regional location and digital inclusion.

The results are presented in Tables 1–4 and interpreted sequentially.

Table 1: Descriptive Statistics by Region

Region	Digital Inclusion Index (0–100)	Teacher Competence (1–5)	ICT Resources (1–5)	Device Count (0–3)	Internet Access (1–5)	SES (1–5)
South-West	72.14	3.89	3.78	2.00	4.01	3.57
South-East	63.79	3.48	3.54	1.63	3.80	3.23
North	46.14	2.78	2.85	0.78	3.26	2.11

Table 1 presents the mean scores for digital inclusion and related educational predictors across the three sampled regions: South-West, South-East, and North. The findings reveal clear regional disparities. The South-West recorded the highest Digital Inclusion Index (M = 72.14), followed by the South-East (M = 63.79), while the North recorded the lowest score (M = 46.14). A similar pattern is observed across teacher digital competence, ICT resource availability, device ownership, internet access, and socio-economic status.

Teacher digital competence is highest in the South-West (M = 3.89) and lowest in the North (M = 2.78). Device ownership shows a substantial gap, with respondents in the South-West owning an average of two devices compared to less than one device in the North. These descriptive results suggest that educational infrastructure and human capacity vary considerably across regions, potentially contributing to digital inequality.

Table 2: One-Way ANOVA for Regional Differences in Digital Inclusion

Source	SS	df	MS	F	p
Between Groups	45,102.92	2	22,551.46	655.97	< .001
Within Groups	13,098.34	381	34.37	—	—
Total	58,201.26	383	—	—	—

Table 2 presents the results of the one-way ANOVA conducted to examine whether regional differences in digital inclusion are statistically significant. The analysis reveals a highly significant difference among the three regions, $F(2, 381) = 655.97$, $p < .001$.

The large F-statistic and statistically significant p-value indicate that digital inclusion levels differ meaningfully across regions. This finding provides empirical support for Hypothesis 1, confirming that regional disparities in digital inclusion are not due to random variation but reflect structural differences across Nigeria's geopolitical zones.

Table 3: Multiple Regression Predicting Digital Inclusion
Dependent variable: Digital Inclusion Index (0–100)

Predictor	B	SE B	β (Std.)	t	p
Constant	18.42	2.95	—	6.24	< .001
Teacher Digital Competence	9.39	0.84	0.56	11.18	< .001
ICT Resources	5.92	0.78	0.31	7.59	< .001
Device Count	6.88	1.05	0.27	6.55	< .001
Socio-Economic Status	0.91	0.72	0.05	1.26	.208
School Type (Private = 1)	–2.14	1.02	–0.08	–2.10	.036

Model statistics:

- $R = 0.74$
- $R^2 = 0.55$
- Adjusted $R^2 = 0.54$
- $F(5, 378) = 92.41$
- $p < .001$

Table 3 presents the results of the multiple regression analysis predicting digital inclusion. The model is statistically significant, $F(5, 378) = 92.41$, $p < .001$, and explains 55% of the variance in digital inclusion ($R^2 = 0.55$), indicating strong explanatory power.

Teacher digital competence emerges as the strongest predictor ($\beta = 0.56$, $p < .001$), suggesting that improvements in teacher capability substantially increase digital inclusion scores. ICT resource availability ($\beta = 0.31$, $p < .001$) and device ownership ($\beta = 0.27$, $p < .001$) also significantly predict digital inclusion. In contrast, socio-economic status is not statistically significant ($p = .208$) once educational variables are included, indicating that educational factors exert stronger influence than income-related proxies in this model.

School type shows a small but significant negative coefficient ($\beta = –0.08$, $p = .036$), suggesting slight variation between public and private institutions after controlling for other factors. Overall, these findings support Hypotheses 2–4 and highlight the central role of educational variables in shaping digital inclusion.

Table 4: Bootstrapped Mediation Analysis

Path	B	SE	t/z	p	95% CI Lower	95% CI Upper
Region (North) → Teacher Competence (a)	–0.90	0.08	–11.25	< .001	–1.06	–0.74
Teacher Competence → Digital Inclusion (b)	9.39	0.84	11.18	< .001	7.74	11.04
Total Effect (c)	–21.82	1.85	–11.80	< .001	–25.45	–18.19
Indirect Effect (a × b)	**–8.45**	—	—	—	**–10.12**	**–6.91**

Table 4 presents the results of the bootstrapped mediation analysis examining whether teacher digital competence mediates the relationship between regional location (North) and digital inclusion. The direct path from regional location to teacher competence is statistically significant ($B = –0.90$, $p < .001$), indicating that respondents in the North report significantly lower teacher digital competence levels.

Teacher digital competence significantly predicts digital inclusion ($B = 9.39$, $p < .001$), confirming its strong positive influence on digital inclusion outcomes.

The bootstrapped indirect effect ($a \times b = –8.45$) is statistically significant, as the 95% bias-corrected confidence interval [–10.12, –6.91] does not include zero. This confirms the presence of a significant mediation effect. The results indicate that teacher digital competence partially mediates the relationship between regional location and digital inclusion.

This finding suggests that a substantial portion of regional disparities in digital inclusion operates through differences in teacher capability. In practical terms, improving teacher digital competence in structurally disadvantaged regions could significantly reduce regional digital inequality.

DISCUSSION OF FINDINGS

The findings of this study provide robust empirical evidence that digital inclusion in Nigeria is deeply structured by regional and educational inequalities. The results confirm that significant regional disparities exist, with the South-West demonstrating the highest levels of digital inclusion and the North recording substantially lower scores. These findings align with broader Sub-Saharan African digital inequality trends documented by the International Telecommunication Union and the World Bank, which highlight uneven infrastructure distribution and institutional capacity across regions.

The strong regional differences observed in the ANOVA analysis reflect historically entrenched disparities in educational investment, electricity access, and ICT infrastructure. The North's lower digital inclusion scores appear closely tied to weaker teacher digital competence, lower device ownership, and limited ICT resource availability. This reinforces structural

inequality perspectives suggesting that geography in Nigeria often reflects differential access to institutional and developmental resources.

One of the most significant findings of the study is the dominant role of teacher digital competence. The regression results show that teacher competence is the strongest predictor of digital inclusion, with a standardized beta coefficient substantially larger than other predictors. This finding supports the human capital development framework underpinning the study and underscores that digital inclusion is not solely an infrastructure issue but fundamentally a skills and capacity issue.

The mediation analysis provides further insight by demonstrating that teacher digital competence partially explains regional disparities in digital inclusion. This indicates that even where infrastructure differences exist, improving teacher capability could significantly reduce digital inequality. The implication is clear: investment in human capacity development offers one of the most scalable and cost-effective pathways to narrowing regional digital gaps.

Interestingly, socio-economic status was not statistically significant once educational variables were included in the regression model. This challenges common assumptions that income alone determines digital inclusion. Instead, the findings suggest that structured educational interventions may offset some socio-economic disadvantages, particularly when schools provide access to digital tools and competent instruction.

Device ownership and ICT resource availability also significantly predict digital inclusion, confirming that access remains important. However, access alone is insufficient without competent teachers capable of integrating digital tools into pedagogical processes. This finding aligns with contemporary digital divide scholarship distinguishing between access gaps and skills gaps.

The relatively modest effect of school type suggests that institutional category (public vs. private) matters less than the quality of digital resources and teacher competence within schools. This shifts the policy focus away from sector-based assumptions and toward quality-based interventions.

The study advances understanding of digital inequality in three key ways. First, it quantifies regional digital disparities within Nigeria using rigorous statistical analysis. Second, it demonstrates the centrality of teacher digital competence as both a predictor and mediator. Third, it clarifies that educational variables exert stronger influence than socio-economic status when examined simultaneously.

These findings reinforce the argument that digital transformation strategies in Sub-Saharan Africa must move beyond connectivity expansion toward comprehensive human capital development. Without targeted educational reforms, digital infrastructure investments alone may fail to produce inclusive outcomes.

Policy Recommendations

Based on the empirical findings and the observed regional disparities, the following policy recommendations are proposed to enhance digital inclusion through education in Nigeria and similar Sub-Saharan African contexts.

Prioritising Teacher Digital Competence Development:

Given that teacher digital competence emerged as the strongest predictor and a key mediating factor of digital inclusion, education policies should place sustained emphasis on capacity building for teachers. Federal and state governments should institutionalise continuous professional development programmes focused on digital pedagogy, ensuring that teachers are regularly updated on emerging educational technologies. In addition, teacher training colleges and universities should integrate compulsory ICT-pedagogy modules into pre-service teacher education programmes. To address regional inequalities, targeted digital skills interventions should be implemented in the northern and other educationally disadvantaged regions to ensure equitable capacity development nationwide.

Expanding ICT Infrastructure in Schools:

Persistent infrastructure deficits continue to undermine digital inclusion in many schools. Governments at all levels should therefore prioritise investments in reliable electricity supply, broadband internet connectivity, and well-equipped computer laboratories within educational institutions. To complement public funding, public–private partnerships should be actively encouraged to support school connectivity and infrastructure development initiatives. Special attention should be given to rural and underserved communities in order to reduce the widening urban–rural digital divide.

Improving Access to Digital Devices:

Since device ownership is a significant predictor of digital inclusion, policies should focus on expanding access to affordable digital devices for learners. Subsidised device acquisition schemes can be introduced to support students from low-income households. Schools should also be encouraged to establish shared digital learning centres where students can access computers and internet facilities. Furthermore, community-based digital hubs can serve as alternative access points for learners in remote and hard-to-reach areas.

Integrating Digital Literacy into the National Curriculum:

To sustain long-term digital inclusion, digital literacy must be systematically embedded across all levels of education. Education authorities should introduce compulsory digital literacy courses from primary through tertiary education, covering areas such as basic computing, coding, online safety, information literacy, and collaborative digital tools. Curriculum reforms should be aligned with national digital economy and innovation strategies to ensure that graduates possess relevant and future-ready digital skills.

Strengthening Institutional Capacity and Governance:

Effective implementation of digital inclusion policies requires strong institutional frameworks and governance structures. Educational institutions should improve monitoring, evaluation, and maintenance systems for ICT facilities to ensure sustainability. Governments should also provide dedicated budgetary allocations for school-based ICT programmes to avoid reliance on ad hoc funding. In addition, stronger coordination and policy coherence should be fostered among the ministries responsible for education, communications, and technology to ensure a unified and effective approach to digital inclusion. Contribution to Knowledge

This study makes several important contributions to the literature on digital inclusion and education in Sub-Saharan Africa. It offers one of the first multi-regional quantitative analyses of digital inclusion across Nigeria's geopolitical zones, thereby filling a notable empirical gap in the existing literature. The findings provide robust evidence of the central role of teacher digital competence, showing it to be the strongest predictor of digital inclusion and a significant mediating factor between regional location and digital outcomes. In addition, the study clarifies the relative influence of educational and socio-economic factors, as the regression results reveal that educational variables exert a stronger effect on digital inclusion than socio-economic status, contrary to commonly held assumptions. Finally, by generating quantitative evidence from a lower-middle-income country context, the study extends the digital inclusion literature and contributes meaningfully to global debates on digital equity.

Limitations of the Study

Despite its contributions, the study has several limitations. First, the cross-sectional design captures data at a single point in time, which restricts the ability to make causal inferences among the variables examined. In addition, key measures such as teacher competence, device ownership, and socio-economic status are based on self-reported data, which may introduce response bias and affect the accuracy of the findings. The study also aggregates states into broad geopolitical regions, a strategy that may obscure important intra-regional differences. Furthermore, the model does not incorporate other potentially influential variables, including school leadership, the quality of policy implementation, and parental educational background. Finally, although the sample size of 384 respondents is statistically adequate, it may not fully reflect the diversity and complexity of Nigeria's educational landscape.

CONCLUSION

This study demonstrates that digital inclusion in Nigeria is strongly shaped by educational factors, particularly teacher digital competence, ICT resources, and access to digital devices. Regional disparities are significant, with the North experiencing markedly lower levels of digital inclusion than the South-West and South-East.

The mediation analysis reveals that teacher digital competence partly explains these regional differences, highlighting the central role of human capacity development in digital inclusion strategies. While infrastructure and socio-economic factors remain important, the findings suggest that investments in teacher training and digital pedagogy offer the most immediate and scalable pathway to improving digital inclusion.

Addressing regional inequalities will require coordinated efforts involving infrastructure development, curriculum reform, teacher training, and institutional strengthening. Without targeted interventions, existing educational disparities risk translating into deeper digital and economic exclusion.

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