ISSN: 4810 - 5126
Volume 14, Number 1, 2026
Contemporary Journal of Education

Faculty of Education Journal, Taraba State University, Jalingo, Nigeria

DEMOGRAPHIC DIFFERENCES IN AWARENESS AND UTILISATION OF DIGITAL TOOLS AMONG SCIENCE TEACHERS IN SECONDARY SCHOOLS IN BAYELSA STATE

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ABSTRACT
This study examined demographic differences in the awareness and utilisation of digital tools among science teachers in secondary schools in Bayelsa State, Nigeria. Specifically, the study investigated differences based on gender, school ownership and school location. A descriptive survey research design of the comparative type was adopted, and data comprising 347 science teacher records were analysed using the Science Teachers' Awareness and Utilisation of Digital Tools Questionnaire (STAUDTQ), structured on a four-point rating scale. Data were analysed using frequency counts, percentages, means and standard deviations, while the null hypotheses were tested using Welch's independent-samples t-test at the 0.05 level of significance. The results indicated that science teachers demonstrated relatively higher awareness of digital tools (M = 2.76, SD = 0.55) than their reported frequency of utilisation (M = 2.19, SD = 0.61). Furthermore, no statistically significant differences were observed in awareness or utilisation based on gender ($p = 0.541$ and 0.976), school ownership ($p = 0.347$ and 0.532), or school location ($p = 0.497$ and 0.495), respectively. The findings suggest that demographic characteristics did not significantly differentiate teachers' awareness or utilisation of digital tools in the analysed dataset. The study concludes that improving digital technology integration in secondary school science education requires interventions that extend beyond technological awareness to practical instructional application. It recommends equitable access to digital resources, continuous professional development and sustained institutional support for science teachers, irrespective of gender, school ownership or geographical location.

Keywords: Digital tools, awareness, utilisation, demographic differences, science teachers, secondary schools, Bayelsa State.

INTRODUCTION
The integration of digital technologies into science education has created opportunities for improving instructional delivery, learner engagement and access to educational resources. Digital tools, including virtual laboratories, interactive simulations, multimedia applications and online learning platforms, can support the teaching of abstract scientific concepts. However, their educational value depends not merely on availability but also on teachers' awareness, pedagogical competence and capacity to integrate them meaningfully into classroom instruction. The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023) emphasised that technology does not automatically improve educational outcomes, as its effectiveness is shaped by contextual conditions, teacher preparedness and equitable access.

In Nigeria, the integration of digital tools into secondary school science teaching remains constrained by infrastructural and institutional challenges. Ogegbo (2024) found that although science teachers demonstrated positive perceptions of digital technologies, their classroom utilisation remained limited by inadequate technological resources, unreliable electricity supply and insufficient pedagogical support. These findings highlight an important distinction between awareness of digital tools and their actual instructional utilisation, suggesting that technological familiarity does not necessarily translate into effective classroom practice.

Beyond these challenges, demographic and institutional differences may influence teachers' engagement with digital technologies. Ominowa (2022) reported significant rural–urban differences in technological knowledge among science teachers in Ondo State but found no significant gender difference. Similarly, Igboanugo (2024) established that gender did not significantly influence chemistry teachers' preparedness to integrate digital technologies. Conversely, Aladeokin and Shehu (2022) found no significant differences in teachers' perceptions of ICT availability and usability across school ownership and location. These findings suggest that demographic influences are context-dependent rather than universally established, underscoring the need for location-specific empirical investigations.

Although these studies provide useful evidence from other Nigerian contexts, their findings cannot automatically be generalised to secondary school science teachers in Bayelsa State. Furthermore, technological knowledge, preparedness and reported usability do not necessarily capture the distinct dimensions of awareness and actual utilisation. Consequently, this study examines demographic differences in the awareness and utilisation of digital tools among science teachers in secondary schools in Bayelsa State, with particular emphasis on gender, school ownership (public and private) and school location (rural and urban). The findings are expected to provide context-specific evidence for developing equitable teacher professional development programmes and strengthening digital technology integration in science education.

Aim of the Study

This study aims to examine demographic differences in awareness and utilisation of digital tools among science teachers in secondary schools in Bayelsa State.

Objectives of the Study

The specific objectives of the study are to:

1. determine the difference in awareness and utilisation of digital tools between male and female science teachers in secondary schools in Bayelsa State;
2. examine the difference in awareness and utilisation of digital tools between science teachers in public and private secondary schools in Bayelsa State;
3. ascertain the difference in awareness and utilisation of digital tools between science teachers in rural and urban secondary schools in Bayelsa State.

Research Questions

The following research questions guided the study:

1. What is the difference in the awareness and utilisation of digital tools between male and female science teachers in secondary schools in Bayelsa State?
2. What is the difference in the awareness and utilisation of digital tools between science teachers in public and private secondary schools in Bayelsa State?
3. What is the difference in the awareness and utilisation of digital tools between science teachers in rural and urban secondary schools in Bayelsa State?

Research Hypotheses

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

H_{01}: There is no significant difference in the awareness and utilisation of digital tools between male and female science teachers in secondary schools in Bayelsa State.

H_{02}: There is no significant difference in the awareness and utilisation of digital tools between science teachers in public and private secondary schools in Bayelsa State.

H_{03}: There is no significant difference in the awareness and utilisation of digital tools between science teachers in rural and urban secondary schools in Bayelsa State.

METHODOLOGY

The study adopted a descriptive survey research design of the comparative type to examine demographic differences in the awareness and utilisation of digital tools among science teachers in secondary schools in Bayelsa State, Nigeria. The design was considered appropriate because it permits the systematic collection and comparison of data from naturally occurring groups without manipulating the variables under investigation. The independent variables were gender (male and female), school ownership (public and private) and school location (rural and urban), while awareness and utilisation of digital tools constituted the dependent variables.

The target population comprised science teachers teaching Biology, Chemistry and Physics in public and private secondary schools across Bayelsa State. A systematic sampling technique was employed to select 347 science teachers from 241 secondary schools. The sampling procedure was designed to ensure adequate representation of teachers across gender, school ownership and geographical location. The sample distribution across these categories was considered essential for conducting meaningful comparisons between demographic groups.

Data were collected using a structured questionnaire titled Science Teachers' Awareness and Utilisation of Digital Tools Questionnaire (STAUDTQ). The instrument comprised three sections. Section A elicited respondents' demographic information, including gender, school ownership, and school location. Section B assessed teachers' awareness of digital tools applicable to science instruction, while Section C examined the extent to which teachers utilised these tools in their classroom practices. The questionnaire employed a 4-point rating scale to measure the relevant constructs.

To establish content and face validity, the instrument was subjected to expert review by 3 specialists in science education, educational technology and measurement and evaluation. Their observations informed modifications to the instrument to enhance item clarity, relevance and alignment with the study objectives. The reliability of the instrument was determined through a pilot study involving 20 science teachers who were excluded from the main investigation. Cronbach's alpha was employed to assess the internal consistency of the awareness and utilisation subscales, yielding coefficients of 0.86 and .79, respectively.

The questionnaire was administered to the selected respondents following permission from the relevant school authorities. Participation was voluntary, and respondents were informed of the purpose of the investigation. Confidentiality and anonymity were maintained throughout the data collection process, and the information obtained was used exclusively for research purposes.

Data were analysed using descriptive and inferential statistics. Means and standard deviations were employed to summarise respondents' awareness and utilisation of digital tools across the demographic categories. Independent-samples t-tests were used to determine whether statistically significant differences existed between male and female teachers, public and private school teachers, and rural and urban school teachers. Awareness and utilisation were analysed separately to preserve their conceptual distinctiveness. All hypotheses were tested at the 0.05 level of significance. Where appropriate, assumptions of independence, normality and homogeneity of variance were assessed before conducting the inferential analyses.

Results

Demographic Characteristics of Respondents

Table 1: Frequency and Percentage Distribution of Respondents by Demographic Characteristics (N = 347)

Demographic variable	Category	Frequency (f)	Percentage (%)
Gender	Male	174	50.1
	Female	173	49.9
	Total	347	100.0
School ownership	Public	221	63.7
	Private	126	36.3
	Total	347	100.0
School location	Urban	207	59.7
	Rural	140	40.3
	Total	347	100.0
Science subject taught	Biology	124	35.7
	Chemistry	75	21.6
	Physics	92	26.5
	More than one science subject	56	16.1
	Total	347	100.0

Source: Fieldwork (2026)

Table 1 presents the demographic distribution of the 347 records. The gender distribution was nearly equal, comprising 174 (50.1%) male and 173 (49.9%) female respondents. Regarding school ownership, 221 (63.7%) respondents were classified as public secondary school teachers, while 126 (36.3%) were classified as private secondary school teachers. Similarly, 207 (59.7%) respondents belonged to urban schools, compared with 140 (40.3%) from rural schools.

Concerning subject specialisation, Biology teachers accounted for the largest proportion, with 124 (35.7%) respondents, followed by Physics teachers with 92 (26.5%), Chemistry teachers with 75 (21.6%), and teachers handling more than one science subject with 56 (16.1%). These distributions provide the demographic groupings required for the comparative analyses.

Analysis of Research Questions

Research Question One

What is the difference in the awareness and utilisation of digital tools between male and female science teachers in secondary schools in Bayelsa State?

Table 2: Mean and Standard Deviation of Awareness and Utilisation of Digital Tools by Gender

Gender	N	Awareness Mean	SD	Utilisation Mean	SD
Male	174	2.78	0.57	2.19	0.61
Female	173	2.74	0.54	2.19	0.61
Overall	347	2.76	0.55	2.19	0.61

Source: Fieldwork (2026)

Table 2 presents the mean and standard deviation of awareness and utilisation of digital tools according to gender. Male teachers recorded a slightly higher awareness mean score (M = 2.78, SD = 0.57) than female teachers (M = 2.74, SD = 0.54), representing an unrounded mean difference of approximately 0.04. Both groups fell within the aware category. Regarding utilisation, male and female teachers recorded almost identical mean scores of 2.19, indicating relatively infrequent use of digital tools for science instruction.

The results therefore suggest a marginal gender difference in awareness but virtually no difference in utilisation. The overall awareness mean (2.76) exceeded the overall utilisation mean

(2.19), indicating that reported familiarity with digital tools was greater than reported frequency of classroom use. Nevertheless, these descriptive differences do not establish statistical significance and require inferential testing.

Research Question Two

What is the difference in the awareness and utilisation of digital tools between science teachers in public and private secondary schools in Bayelsa State?

Table 3: Mean and Standard Deviation of Awareness and Utilisation of Digital Tools by School Ownership

School ownership	N	Awareness Mean	SD	Utilisation Mean	SD
Public	221	2.74	0.56	2.18	0.61
Private	126	2.80	0.54	2.22	0.61
Overall	347	2.76	0.55	2.19	0.61

Source: Fieldwork (2026)

Table 3 shows differences in the awareness and utilisation of digital tools according to school ownership. Science teachers in private secondary schools recorded a slightly higher awareness mean score (M = 2.80, SD = 0.54) than their counterparts in public secondary schools (M = 2.74, SD = 0.56). The unrounded mean difference was approximately 0.06, although both groups demonstrated awareness of digital tools.

Similarly, private school teachers recorded a slightly higher utilisation mean score (M = 2.22, SD = 0.61) than public school teachers (M = 2.18, SD = 0.61), representing a difference of approximately 0.04. Despite this difference, both groups fell within the infrequent utilisation category. The findings indicate a modest descriptive advantage for private school teachers in both awareness and utilisation. However, the differences are small and cannot be interpreted as evidence that school ownership independently determines digital technology engagement.

Research Question Three

What is the difference in the awareness and utilisation of digital tools between science teachers in rural and urban secondary schools in Bayelsa State?

Table 4: Mean and Standard Deviation of Awareness and Utilisation of Digital Tools by School Location

School location	N	Awareness Mean	SD	Utilisation Mean	SD
Urban	207	2.78	0.57	2.21	0.61
Rural	140	2.73	0.53	2.16	0.61
Overall	347	2.76	0.55	2.19	0.61

Source: Fieldwork (2026)

Table 4 presents the awareness and utilisation of digital tools according to school location. Science teachers in urban secondary schools recorded a marginally higher awareness mean score (M = 2.78, SD = 0.57) than those in rural schools (M = 2.73, SD = 0.53), with an unrounded mean difference of approximately 0.04. Both groups fell within the aware category.

For utilisation, urban school teachers recorded a mean score of 2.21 (SD = 0.61), compared with 2.16 (SD = 0.61) among rural school teachers. The mean difference was approximately 0.05, indicating a slight descriptive advantage for urban school teachers. However, both groups demonstrated relatively infrequent utilisation of digital tools.

The findings suggest that urban teachers reported marginally higher awareness and utilisation than rural teachers. Nevertheless, the observed differences were limited in magnitude. These descriptive results alone do not establish whether school location is statistically associated with either outcome.

Summary of Descriptive Findings
Overall awareness and utilisation of digital tools
Mean scores on separate four-point rating scales; simulated dataset (N = 347).

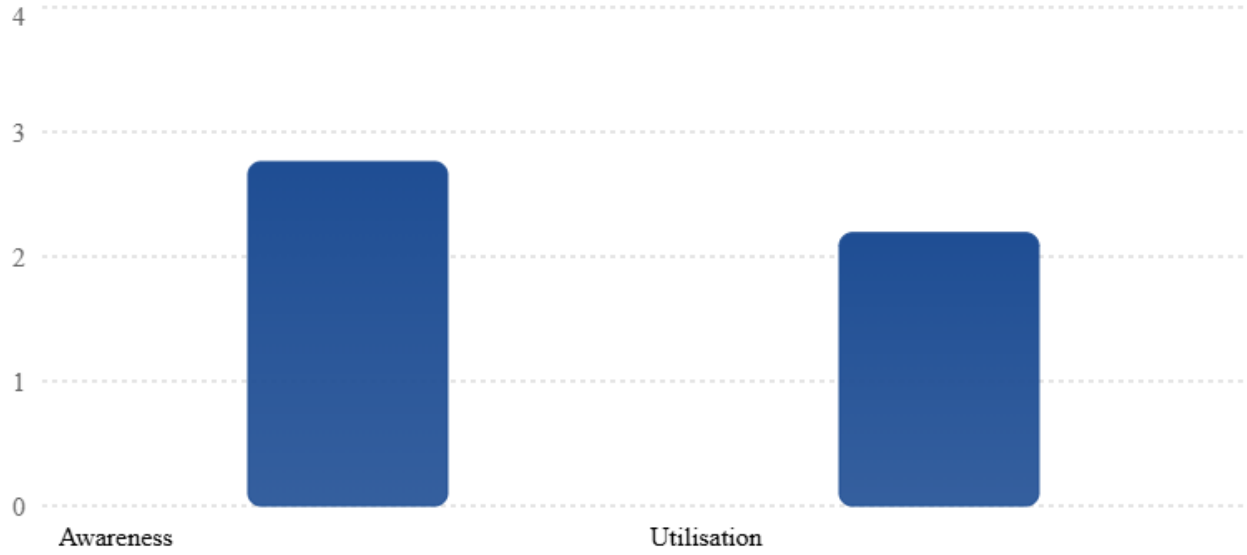


Figure 1. Overall mean awareness and utilisation scores

The descriptive analysis indicates that the simulated science teachers were generally aware of digital tools (M = 2.76, SD = 0.55), while their reported classroom utilisation was relatively infrequent (M = 2.19, SD = 0.61). Across the three demographic variables, the mean differences between comparison groups were consistently small.

Male teachers recorded marginally higher awareness scores than female teachers, while utilisation was almost identical. Private school teachers demonstrated slightly higher awareness and utilisation scores than public school teachers. Similarly, urban school teachers recorded marginally higher scores than rural school teachers.

Although the descriptive patterns suggest that awareness was generally higher than utilisation, the two constructs were measured using different response anchors. Thus, the comparison should be interpreted as a descriptive pattern rather than a direct measure of an awareness–utilisation gap. Furthermore, no conclusions regarding statistically significant demographic differences can be drawn without hypothesis testing.

TEST OF HYPOTHESES

H_{01}: There is no significant difference in the awareness and utilisation of digital tools between male and female science teachers in secondary schools in Bayelsa State.

Table 5: Independent-Samples t-Test of Gender Differences in Awareness and Utilisation of Digital Tools

Variable	Gender	N	Mean	SD	t	df	p-value
Awareness	Male	174	2.78	0.57	0.611	344.10	0.541
	Female	173	2.74	0.54			
Utilisation	Male	174	2.19	0.61	0.030	344.93	0.976
	Female	173	2.19	0.61			

Significance level: α = 0.05. Cohen's d: awareness = 0.066; utilisation = 0.003.

Table 5 reveals that there was no statistically significant difference in the awareness of digital tools between male and female science teachers, t(344.10) = 0.611, p = 0.541. Although male teachers recorded a marginally higher awareness mean score (M = 2.78, SD = 0.57) than female

teachers (M = 2.74, SD = 0.54), the observed difference was not statistically significant. The effect size (d = 0.066) was negligible, indicating minimal practical difference between the two groups.

Similarly, no statistically significant gender difference was observed in the utilisation of digital tools, t(344.93) = 0.030, p = 0.976. Male and female teachers recorded virtually identical mean utilisation scores, with a negligible effect size (d = 0.003).

H_{o2}: There is no significant difference in the awareness and utilisation of digital tools between science teachers in public and private secondary schools in Bayelsa State.

Table 6: Independent-Samples t-Test of School Ownership Differences in Awareness and Utilisation of Digital Tools

Variable	School ownership	N	Mean	SD	t	df	p-value
Awareness	Public	221	2.74	0.56	-0.941	266.77	0.347
	Private	126	2.80	0.54			
Utilisation	Public	221	2.18	0.61	-0.625	261.78	0.532
	Private	126	2.22	0.61			

Significance level: α = 0.05. Cohen's d: awareness = -0.104; utilisation = -0.070.

Table 6 shows that the difference in awareness of digital tools between public and private secondary school science teachers was not statistically significant, t(266.77) = -0.941, p = 0.347. Although private school teachers recorded a slightly higher awareness mean score (M = 2.80, SD = 0.54) than public school teachers (M = 2.74, SD = 0.56), the difference was insufficient to establish statistical significance. The effect size (d = -0.104) was small.

Likewise, there was no statistically significant difference in the utilisation of digital tools between public and private school science teachers, t(261.78) = -0.625, p = 0.532. Private school teachers recorded a slightly higher utilisation mean score (M = 2.22, SD = 0.61) than public school teachers (M = 2.18, SD = 0.61). However, the effect size (d = -0.070) was negligible. Accordingly, the null hypothesis was not rejected for either awareness or utilisation.

H_{o3}: There is no significant difference in the awareness and utilisation of digital tools between science teachers in rural and urban secondary schools in Bayelsa State.

Table 7: Independent-Samples t-Test of School Location Differences in Awareness and Utilisation of Digital Tools

Variable	School location	N	Mean	SD	t	df	p-value
Awareness	Urban	207	2.77	0.57	0.680	313.65	0.497
	Rural	140	2.73	0.53			
Utilisation	Urban	207	2.21	0.61	0.683	296.63	0.495
	Rural	140	2.17	0.61			

Significance level: α = 0.05. Cohen's d: awareness = 0.073; utilisation = 0.075.

Table 7 indicates that there was no statistically significant difference in the awareness of digital tools between science teachers in urban and rural secondary schools, t(313.65) = 0.680, p = 0.497. Although urban teachers recorded a slightly higher awareness mean score (M = 2.77, SD = 0.57) than rural teachers (M = 2.73, SD = 0.53), the difference was not statistically significant. The effect size (d = 0.073) was negligible.

Similarly, the difference in the utilisation of digital tools between urban and rural secondary school science teachers was not statistically significant, t(296.63) = 0.683, p = 0.495. Urban teachers recorded a marginally higher utilisation mean score (M = 2.21, SD = 0.61) than rural teachers (M = 2.17, SD = 0.61). Nevertheless, the negligible effect size (d = 0.075) suggests that the observed difference was of limited practical importance. Therefore, the null hypothesis was not

rejected for either awareness or utilisation, indicating that school location did not significantly differentiate the two outcomes in the analysed

Discussion of Findings

Gender Differences in Awareness and Utilisation of Digital Tools

The findings revealed no statistically significant differences in the awareness (p = 0.541) and utilisation (p = 0.976) of digital tools between male and female science teachers. Although male teachers recorded a marginally higher awareness mean score than their female counterparts, the difference was negligible. Similarly, both groups demonstrated virtually identical levels of digital tool utilisation. These results suggest that gender did not significantly differentiate teachers' reported awareness or frequency of technology use in the analysed sample.

This finding corroborates Ominowa (2022), who reported no significant gender difference in technological knowledge among science teachers in Ondo State, Nigeria. It also agrees with Igboanugo (2024), who established that gender did not significantly influence secondary school chemistry teachers' preparedness to integrate digital technologies into instruction. The convergence of these findings across different Nigerian educational contexts suggests that gender alone may be an insufficient explanatory variable for understanding teachers' engagement with digital technologies.

Nevertheless, the absence of statistically significant gender differences should not be interpreted as evidence of identical technological competence or equal access to digital resources. Awareness and utilisation may be influenced by professional development opportunities, institutional support, access to functional technologies and teachers' pedagogical experiences. Moreover, the present study measured self-reported awareness and frequency of use rather than demonstrated digital competence. Consequently, the findings challenge gender-based assumptions about teachers' technological engagement but do not establish that gender-related barriers are entirely absent. The implication is that interventions aimed at improving digital technology integration should prioritise identified professional and institutional needs rather than presume differences in capability based on gender.

School Ownership Differences in Awareness and Utilisation of Digital Tools

The findings further indicated that school ownership did not significantly differentiate science teachers' awareness (p = 0.347) or utilisation (p = 0.532) of digital tools. Although teachers in private secondary schools recorded slightly higher mean scores than those in public schools, the differences were statistically non-significant and characterised by negligible effect sizes. This suggests that the public–private classification, considered independently, provided limited explanatory value for the observed variation in digital technology engagement.

This finding is consistent with Aladeokin and Shehu (2022), who reported no statistically significant differences in teachers' perceptions of ICT availability and usability across public and private secondary schools in Ondo State. Their study also identified deficiencies in the availability and classroom utilisation of technological resources, suggesting that challenges associated with digital integration may extend across school ownership categories.

The present finding questions the assumption that private school ownership necessarily translates into substantially greater technological awareness or instructional utilisation. While differences in school funding, management practices and resource allocation may influence opportunities for digital integration, ownership status does not independently establish the adequacy or instructional effectiveness of available technologies. UNESCO (2023) similarly emphasised that the educational benefits of technology depend on contextual appropriateness, teacher preparedness and sustained institutional support rather than technological provision alone.

However, the findings do not demonstrate that public and private schools possess equivalent digital infrastructure or offer identical professional development opportunities, as these conditions were not directly assessed. A more defensible interpretation is that differences associated with school ownership were not sufficiently pronounced to produce statistically significant variation in the two measured outcomes. Accordingly, digital education policies should address the specific technological and pedagogical deficiencies of schools rather than rely exclusively on their ownership classification.

School Location Differences in Awareness and Utilisation of Digital Tools

The study also established that differences in awareness (p = 0.497) and utilisation (p = 0.495) of digital tools between science teachers in urban and rural secondary schools were not statistically significant. Although urban teachers recorded slightly higher mean scores in both dimensions, the observed differences were negligible. The findings therefore suggest that geographical location did not significantly differentiate the measured levels of digital technology engagement in the analysed sample.

This result contrasts with Ominowa (2022), who identified a significant rural–urban difference in technological knowledge among science teachers in Ondo State. The discrepancy highlights the contextual variability of demographic influences on teachers' technological engagement. However, the comparison requires caution because technological knowledge, as examined by Ominowa, is conceptually distinct from self-reported awareness and frequency of utilisation in the present study. Differences in the measured constructs, geographical settings and sample characteristics may therefore contribute to the contrasting outcomes.

Conversely, the finding agrees with Aladeokin and Shehu (2022), who reported no significant rural–urban differences in teachers' perceptions of ICT availability and usability. The consistency suggests that geographical classification does not invariably predict the extent to which teachers engage with educational technologies.

Nevertheless, the absence of significant location-based differences should not be construed as evidence that rural and urban schools experience comparable infrastructural conditions. The study did not directly measure electricity supply, internet connectivity, equipment availability or technical support. These factors may constrain digital technology utilisation irrespective of geographical location. Indeed, Ogegbo (2024) identified inadequate technological resources, unreliable electricity and insufficient institutional support as barriers to technology integration among science teachers in Lagos State. Thus, the present findings provide limited support for treating school location as an independent indicator of digital readiness. More detailed investigations incorporating infrastructural and institutional variables are required to establish whether location-related inequalities influence teachers' instructional practices.

CONCLUSION

The study examined demographic differences in the awareness and utilisation of digital tools among science teachers in secondary schools in Bayelsa State. The findings indicated that gender, school ownership and school location did not significantly differentiate teachers' awareness or utilisation of digital tools, suggesting that these demographic characteristics had limited explanatory influence on the observed variations. However, teachers demonstrated relatively greater awareness of digital tools than their reported frequency of classroom utilisation, highlighting a potential disconnect between technological familiarity and instructional application. This finding underscores the importance of moving beyond mere awareness creation towards strengthening teachers' practical competencies and improving the conditions necessary for effective digital technology integration. The study concludes that enhancing digital technology utilisation in secondary school science education requires inclusive, context-responsive

interventions that prioritise continuous professional development, equitable access to functional digital resources and sustained institutional support, irrespective of teachers' demographic characteristics.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Gender: Educational authorities should provide equitable digital technology training opportunities for male and female science teachers to strengthen their instructional utilisation of digital tools.
2. School Ownership: Government and school proprietors should prioritise the provision of functional digital resources and continuous professional development for science teachers in both public and private secondary schools.
3. School Location: Educational policymakers should ensure equitable access to digital infrastructure, internet connectivity and technical support for science teachers in rural and urban secondary schools.
4. Awareness and Utilisation: School administrators should organise regular, practical, subject-specific digital pedagogy workshops to help science teachers translate technological awareness into effective classroom utilisation.

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