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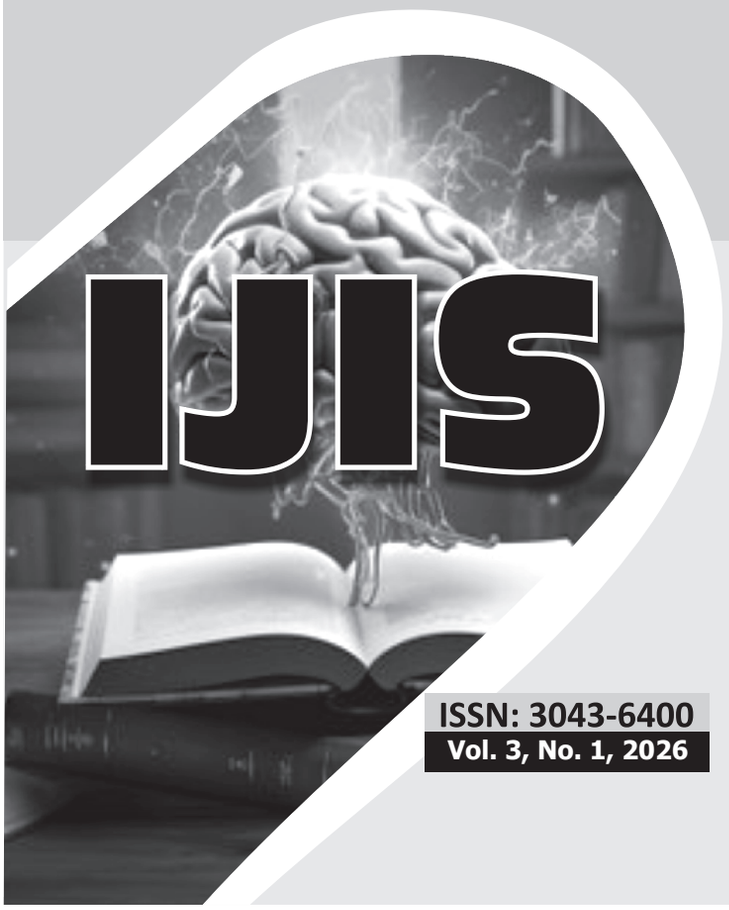

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INVESTIGATION INTO CHEMISTRY TEACHERS' INSIGHTS ON REPOSITIONING CHEMISTRY EDUCATION IN NIGERIA THROUGH DIGITAL TECHNOLOGY

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INVESTIGATION INTO CHEMISTRY TEACHERS' INSIGHTS ON REPOSITIONING CHEMISTRY EDUCATION IN NIGERIA THROUGH DIGITAL TECHNOLOGY

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Abstract
The integration of digital technology has the potential to transform the teaching and learning of chemistry by making abstract concepts more engaging and accessible. However, in Nigeria, the adoption of digital tools in chemistry classrooms remains constrained by infrastructural and capacity-related challenges. This study examined chemistry teachers' insights on repositioning chemistry education in Nigeria through digital technology. A descriptive survey design was adopted, involving 86 chemistry teachers drawn from secondary and tertiary institutions. Data were collected using a structured questionnaire and analyzed using mean, standard deviation, t-test, and ANOVA. Findings revealed that teachers demonstrated a highly positive perception of digital technology but possessed only moderate digital competence. Key challenges identified include poor internet connectivity, inadequate access to digital devices, unstable electricity supply, and limited training opportunities. The t-test results indicated no significant difference in teachers' perspectives based on gender, while ANOVA results showed a significant difference based on qualification and computer literacy. The study concluded that effective repositioning of chemistry education in Nigeria requires improved digital infrastructure and capacity-building initiatives to enhance teachers' technological skills and confidence. It recommended increased investment in ICT facilities, integration of digital pedagogy in teacher education curricula, and the establishment of strong policy frameworks to support sustainable digital transformation in chemistry education.

Keywords: Chemistry teachers', digital technology, perspectives, repositioning.

Introduction

Chemistry education plays a pivotal role in advancing scientific literacy, technological innovation, and socio-economic development in contemporary societies. As a core science subject, it provides learners with fundamental knowledge and problem-solving skills necessary for higher education, industry, and national development (Akinsola & Olatunji, 2023). However, despiteits importance, chemistry education in Nigeria continues to face significant challenges, including poor students' performance, inadequate instructional resources, and limited use of innovative teaching approaches (Ezeet al. 2022). These challenges have necessitated calls for repositioning chemistry education to meet the demands of the 21st-century learning environment, particularly through the integration of digital technology.

Globally, digital technology has transformed the educational landscape by enhancing access to information, facilitating interactive learning, and supporting innovative pedagogical practices (World Bank, 2023). Tools such as virtual laboratories, simulations, animations, and learning management systems have been shown to improve students' conceptual understanding and engagement in science education (Aljazzaf, 2022; Park & Kim, 2021). In chemistry, which is often perceived as abstract and difficult, the use of digital resources offers students opportunities to visualize molecular interactions, conduct experiments virtually, and collaborate with peers in problem-solving (Obi & Nwosu, 2023). Consequently, effective digital integration has the potential to address long-standing issues of poor comprehension, low interest, and underachievement in the subject.

In Nigeria, the adoption of digital technology in education has been uneven and fraught with systemic barriers. Studies report persistent problems such as inadequate ICT infrastructure, poor internet

connectivity, limited digital literacy among teachers, and insufficient policy implementation (Adedoyin & Akinyemi, 2023; Olagbaju & Ogunlade, 2022). These challenges are particularly pronounced in science subjects like chemistry, where the demand for simulations, software, and stable connectivity is relatively high. While government initiatives and private sector interventions have attempted to promote technology integration, the pace of progress has remained slow, raising concerns about the ability of Nigerian students to compete in an increasingly digitalized global economy (UNESCO, 2022).

Teachers occupy a central position in the drive to reposition chemistry education through digital technology. Their perceptions, competencies, and willingness to adopt digital tools significantly influence how effectively technology is integrated into classroom practice (Adeoye & Salami, 2023). Recent evidence indicates that while many Nigerian teachers acknowledge the pedagogical value of digital technologies, factors such as lack of professional training, inadequate support systems, and limited institutional investment constrain their adoption (Okonkwo & Ogbu, 2021; Oladipo, 2022). Understanding teachers' insights is, therefore, crucial for identifying context-specific strategies that can bridge existing digital gaps and enhance the quality of chemistry education.

The study examined the perspectives of chemistry teachers on repositioning chemistry education in Nigeria through the use of digital technology. Specifically, it seeks to explore teachers' awareness, perceived benefits, and challenges in the adoption of digital tools, while also considering demographic factors such as qualification, experience, and digital skills. By doing so, the study contributes to the discourse on digital transformation in science education and provides empirical evidence to guide policymakers, educators, and stakeholders in developing interventions that promote effective and sustainable integration of digital technology in Nigeria's chemistry classrooms.

The study is anchored on two complementary models: Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK).The Technology Acceptance Model (Davis, 1989) posits that users' acceptance of technology is influenced by perceived usefulness and perceived ease of use. Applied to chemistry education, teachers' willingness to adopt digital technologies depends on their belief that such tools will enhance students' learning outcomes and their confidence in being able to use the technologies effectively. Empirical studies confirm that chemistry teachers' perceptions of the relevance, accessibility, and usability of digital tools strongly determine the extent of their integration into classroom practices (Adeoye & Salami, 2023; Park & Kim, 2021).

Additionally, the TPACK framework (Mishra & Koehler, 2006) further emphasizes the intersection of technological, pedagogical, and content knowledge required for effective teaching in a digital environment. In the context of chemistry, teachers must not only understand the subject matter and appropriate pedagogy but also know how digital resources-such as simulations, virtual laboratories, and interactive models-can be integrated to make abstract concepts more concrete (Obi & Nwosu, 2023). Teachers' level of competence in these three domains is critical to repositioning chemistry education in a way that leverages the transformative potential of digital technologies.

Based on these models, the present study conceptualizes the repositioning of chemistry education in Nigeria as a function of four interrelated dimensions: (i) Teachers' perceptions of digital technology, (ii) Teachers' digital competence (iii) Institutional and infrastructural support and (iv) Contextual and demographic factors. This framework guides the present study by highlighting the centrality of teachers' insights in the digital transformation of chemistry education. It assumes that while teachers may recognize the value of digital tools, their ability to effectively implement them depends on adequate infrastructure, professional development, and supportive policies. Consequently, examining teachers' perspectives

provides valuable evidence for policymakers and stakeholders seeking to address barriers and promote sustainable integration of digital technology in Nigerian chemistry classrooms.

Objectives of the Study

Specifically, the intent of the study is to:

(i) explore chemistry teachers' perceptions and digital competence in the use of digital technology for repositioning chemistry education in Nigeria.

(ii) examine the institutional, infrastructural, and contextual challenges affecting the integration of digital technology in chemistry classrooms.

(iii) analyze the influence of demographic factors (such as qualification, experience, gender, and computer literacy) on teachers' perspectives toward digital technology adoption in chemistry education.

Research Questions

1. What are Chemistry teachers' perceptions and levels of digital competence in integrating digital technology for repositioning Chemistry education in Nigeria?
2. What institutional, infrastructural and contextual challenges hinder the effective use of digital technology in teaching and learning of Chemistry?
3. How do demographic factors (qualification, experience, gender and computer literacy) influence teachers' perspectives on the adoption of digital technology in Chemistry education?

Hypotheses

1. There is no significant difference in chemistry teachers' perspectives on the use of digital technology in education based on gender.
2. There is a significant difference in chemistry teachers' perspectives on the use of digital technology in education based on qualification and computer literacy levels.

Methodology

The study adopted a descriptive survey research design. This design

was considered appropriate because it enabled the researcher to collect quantitative data from chemistry teachers and analyze their insights regarding the integration of digital technology in teaching and learning. The design also allowed for the examination of differences in perceptions across demographic variables such as gender, qualification, teaching experience, and computer literacy. The target population for this study comprised chemistry teachers from both secondary and tertiary institutions in Kwara state, Nigeria. A total of 86 participants were purposively selected, representing teachers actively involved in classroom instruction. The sample included teachers with diverse qualifications, teaching experience, and digital literacy levels to ensure variation in perspectives. Data were collected using a structured questionnaire developed by the researcher based on existing literature on digital technology in education (Adeoye & Salami, 2023; Obi & Nwosu, 2023). Items of the instrument were measured on a 4-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (4). The instrument was validated by three experts in science education and educational technology. A pilot test conducted among 20 chemistry teachers (excluded from the main study) yielded a Cronbach's alpha reliability coefficient of 0.82, indicating good internal consistency. The questionnaire was administered to the participants with the assistance of trained research assistants. Informed consent was obtained from all respondents, and participation was voluntary. Respondents were assured of confidentiality and that the data collected would be used strictly for research purposes.

Data collected were analyzed using mean and standard deviation, t-test and Analysis of Variance (ANOVA), were employed to test the hypotheses on differences in perspectives based on demographic factors (gender, qualification and computer literacy). The level of significance was set at 0.05.

Results

This section presents the findings of the study based on the objectives of the study. Both descriptive and inferential statistics were used to analyze the data.

Research Question 1:What are Chemistry teachers' perceptions and levels of digital competence in integrating digital technology for repositioning Chemistry education in Nigeria?

Table 1: Teachers' Perception and Level of Digital Competence

Variable	N	$\overline{X}$	SD	Remark
Perception of digital technology	86	3.72	0.64	High
Level of digital competence	86	2.95	0.71	Moderate
Perceived challenges	86	3.88	0.58	High

Source: Field survey (2025)

From Table 1, chemistry teachers recorded a high mean score ($\bar{X}$ = 3.72) for perception, indicating that they hold a strongly positive view of the role of digital technology in enhancing chemistry teaching and learning. This suggests that most teachers believe digital tools such as simulations, animations, and virtual laboratories can make abstract chemical concepts more concrete and engaging.

However, the mean score for digital competence ($\bar{X}$ = 2.95) falls within the moderate range, implying that while teachers appreciate the usefulness of technology, their practical ability to integrate it effectively remains limited. On a four-point scale interpretation (1.00–1.99 = Low, 2.00–2.99 = Moderate, 3.00–3.99 = High, 4.00 = Very High), this score reflects partial proficiency - for instance, teachers can use basic tools such as PowerPoint and projectors but struggle with advanced digital applications like interactive simulations or online laboratory environments.

The mean score for perceived challenges ($\bar{X}$ = 3.88) is high, signifying that most teachers encounter serious obstacles in adopting technology. The low standard deviations (ranging from 0.58 to 0.71) indicate consistency in respondents' views, meaning that the issues identified are widely shared among the sample. Collectively, these results suggest that Nigerian chemistry teachers are receptive to technology but are hindered by practical and systemic constraints that prevent full utilization.

Research Question 2:What institutional, infrastructural and contextual challenges hinder the effective use of digital technology in

teaching and learning of Chemistry?

Table2: Institutional and Infrastructural Challenges Affecting Digital Integration

Item	$\overline{X}$	SD	Remark
Poor internet connectivity	3.91	0.52	Major challenge
Inadequate access to digital devices	3.85	0.61	Major challenge
Unstable electricity supply	3.94	0.49	Major challenge
Poor administrative support	3.70	0.58	Major challenge
Insufficient digital training opportunities	3.80	0.63	Major challenge
Inadequate technical personnel	3.76	0.57	Major challenge
Limited ICT policy implementation	3.68	0.65	Major challenge

Source: Field survey (2025)

Table 2 reveals that all the listed items have mean scores above 3.60, which indicates a high level of challenge across institutional and infrastructural variables. The most critical issue identified is unstable electricity supply ($\bar{X}$ = 3.94, SD = 0.49), followed closely by poor internet connectivity ($\bar{X}$ = 3.91). These findings suggest that even when digital resources are available, frequent power outages and weak network signals disrupt technology-based instruction.

Similarly, inadequate access to digital devices ($\bar{X}$ = 3.85) and insufficient training opportunities ($\bar{X}$ = 3.80) highlight persistent gaps in resource availability and teacher capacity. The relatively high mean for lack of administrative support ($\bar{X}$ = 3.70) and limited ICT policy implementation ($\bar{X}$ = 3.68) further emphasizes the systemic nature of the problem -institutional leaders often fail to provide enabling environments or follow through on ICT policies designed to enhance digital teaching.

Overall, the uniformly high mean scores (3.68–3.94) indicate that the challenges are not isolated but structural, cutting across technical, infrastructural, and administrative domains. These barriers collectively impede the effective repositioning of chemistry education through digital technology in Nigeria.

Hypothesis 1: There is no significant difference in chemistry teachers' perspectives on the use of digital technology in education based on gender.

Table 3: t-Test Analysis of Teachers' Perspectives by Gender

Gender	N	$\overline{X}$	SD	df	t	Sig	Decision
Male	42	3.68	0.67				
Female	44	3.77	0.61	84	0.92	0.360	Not Significant

Source: Field survey (2025)

Table 3 shows that male teachers ($\overline{X}$ = 3.68) and female teachers ($\overline{X}$= 3.77) do not differ significantly in their perspectives on the use of digital technology in chemistry education, $t(84) = 0.92$, $p = 0.36 > 0.05$. This implies that both male and female teachers equally value digital technology and recognize its importance for enhancing students' learning outcomes. Gender, therefore, is not a determinant of teachers' acceptance or perception of digital integration in chemistry classrooms.

Hypothesis 2: There is a significant difference in chemistry teachers' perspectives on the use of digital technology in education based on qualification and computer literacy levels.

Table 4: ANOVA Summary of Teachers' Perspectives by Qualification and Computer Literacy

Source	SS	df	MS	f	Sig	Decision
Between Groups	4.236	3	1.412			
				4.52	0.006	Significant
Within Groups	25.457	82	0.310			

Source: Field survey (2025)

Table 4 shows that there was a significant difference in teachers' perspectives based on qualification and computer literacy ($F(3,82) = 4.52$, $p = 0.006 < 0.05$). This indicates that teachers with higher qualifications and better computer literacy hold more favorable perceptions of digital technology than their counterparts. The result suggests that digital competence and professional background

enhance teachers' confidence in integrating technology into chemistry instruction.

Discussion of Findings

The purpose of this study was to examine chemistry teachers' perspectives on repositioning chemistry education in Nigeria through digital technology. The findings provide insights into teachers' perceptions, levels of digital competence, challenges of technology integration, and the influence of demographic factors. The study revealed that chemistry teachers generally acknowledged the usefulness of digital technology in making lessons more engaging and enhancing students' understanding of abstract concepts. This finding aligns with prior research indicating that digital tools such as simulations and animations improve conceptual clarity and student participation in science classrooms (Obi & Nwosu, 2023; Park & Kim, 2021). However, the results also showed that teachers' digital competence was only moderate, with relatively low confidence in using advanced technologies such as virtual laboratories. This is consistent with the report of Adeoye and Salami (2023), who noted that many Nigerian teachers recognize the value of digital tools but lack the requisite skills to integrate them effectively into pedagogy.

On institutional and infrastructural Challenges, findings identified inadequate access to digital devices, poor internet connectivity, insufficient training opportunities, unstable electricity supply, and weak institutional policy support as major barriers to technology integration in chemistry classrooms. These challenges reflect systemic issues reported in earlier studies (Adedoyin & Akinyemi, 2023; Olagbaju & Ogunlade, 2022), which emphasized that the digital divide in Nigeria's education sector remains a significant obstacle to effective teaching and learning. The persistence of infrastructural challenges suggests that without substantial investment in digital infrastructure and teacher development, efforts to reposition chemistry education through technology will remain limited.

Also, the results showed no significant differences in teachers'

perspectives based on gender and teaching experience, suggesting that digital technology adoption in chemistry education is not inherently shaped by these variables. This finding supports the observations of Okonkwo and Ogbu (2021), who reported that male and female teachers in Nigerian science classrooms share similar challenges and attitudes toward ICT integration. On the other hand, significant differences were observed based on qualification and computer literacy. Teachers with higher qualifications and better computer skills expressed more positive perspectives toward digital technology adoption. This outcome underscores the role of digital competence and professional development in shaping teachers' readiness to adopt innovative pedagogies. It also echoes the findings of Oladipo (2022), who argued that digital literacy is a crucial determinant of teachers' ability to utilize technology effectively in the classroom.

Conclusion

The study revealed that chemistry teachers in Nigeria hold positive perceptions of digital technology but possess only moderate competence in its use. Major barriers to effective integration include inadequate digital infrastructure, poor internet connectivity, limited access to devices, and insufficient training. Statistical analysis showed no significant gender difference in teachers' perspectives, but significant variation based on qualification and computer literacy. Therefore, improving teachers' digital skills and institutional support is essential for repositioning chemistry education in Nigeria.

Recommendations

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

i. Government and stakeholders should prioritize the provision of reliable internet connectivity, access to digital devices, and stable electricity supply to schools and tertiary institutions to facilitate the effective integration of technology in chemistry education.

ii. Continuous professional development programs should be organized to enhance teachers' digital competence. These

programs should emphasize practical applications of digital tools such as simulations, virtual laboratories, and online learning platforms.

iii. Colleges of education and universities should incorporate digital pedagogy as a core component of preservice teacher training to ensure that future chemistry teachers are well-equipped with the necessary skills for technology-enhanced instruction.

iv. Education policymakers should develop and enforce clear ICT-in-education policies that provide direction, resources, and accountability frameworks for the integration of digital technology in science education.

v. Partnerships between government, private sector, and international organizations should be fostered to support digital initiatives in education, including the provision of funding, training, and innovative digital resources tailored to Nigerian contexts.

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