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Assessment of ICT tool usage in teaching Chemistry among secondary school teachers

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ABSTRACT

The study explored the availability and utilization of ICT tools for chemistry teaching in Offa Local Government Area (LGA) of Kwara State. The study employed a descriptive survey research design. Purposive sampling was adopted to choose twenty-one chemistry teachers from sixteen public senior secondary schools and five private senior secondary schools in Offa LGA for the study. The tool employed to obtain the data was a questionnaire that the researcher designed. The instrument was face-validated by senior lecturers in scientific education and Pearson's Product Moment Correlation Coefficient (PPMC). The study found that the minimal ICT resources available were only moderately used to teach chemistry and that public and private schools in Offa LGA, Kwara State, have some ICT resources. It was suggested that the government give sufficient ICT resources to public schools and that private school owners supply sufficient ICT resources to their schools. It was also suggested that chemistry teachers use ICT resources when instructing Chemistry.

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ABSTRAK

Penelitian ini meneliti ketersediaan dan pemanfaatan perangkat TIK untuk pengajaran kimia di Offa Local Government Area (LGA) di Negara Bagian Kwara. Penelitian ini menggunakan desain penelitian survei deskriptif. Pengambilan sampel secara sengaja dilakukan untuk memilih dua puluh satu guru kimia dari enam belas sekolah menengah atas negeri dan lima sekolah menengah atas swasta di Offa LGA untuk penelitian ini. Perangkat yang digunakan untuk memperoleh data adalah kuesioner yang dirancang oleh peneliti. Instrumen tersebut divalidasi oleh dosen senior dalam pendidikan sains dan Product Moment Correlation Coefficient (PPMC). Penelitian ini menemukan bahwa sumber daya TIK minimal yang tersedia hanya digunakan secara moderat untuk mengajar kimia dan bahwa sekolah negeri dan swasta di Offa LGA, Negara Bagian Kwara memiliki beberapa sumber daya TIK. Di antara hal-hal lain, disarankan agar pemerintah memberikan sumber daya TIK yang cukup untuk sekolah negeri dan agar pemilik sekolah swasta menyediakan sumber daya TIK yang cukup untuk sekolah mereka. Disarankan juga agar guru kimia memanfaatkan sumber daya TIK yang dapat diakses dengan baik saat mengajar Kimia.

Kata Kunci: *asesmen guru; guru kimia; pemanfaatan TIK; perangkat TIK*

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INTRODUCTION

Scientific literacy encompasses a deep understanding of science and its practical application in everyday life, including the ability to connect ideas across various fields. This proficiency in science is crucial for humanity, making it the primary aim of science education (Aragão & Marcodes, 2018). Teaching science in educational settings has evolved through different stages, from focusing on natural science to general science and presently emphasizing basic science (Kola et al., 2019). At present, junior secondary schools in Nigeria incorporate basic science into their curriculum, covering both pure and applied science subjects. The latter includes disciplines like Agricultural Science and Introduction to Technology, while the former encompasses Mathematics, Biology, Physics, and Chemistry (Kola et al.,2019).

In "*Science Self-efficacy in University Level Students: A Phenomenological Study of Organic Chemistry*" by Lotorre, it is explained that chemistry is commonly labeled as an intermediate science as it bridges Physics, Mathematics, and Biology, offering avenues for exploring diverse career paths that nurture problem-solving solid abilities. Chemistry is a branch of science focused on the composition of matter, the study of its properties and reactions, and the application of these reactions to create new substances (Nelson, 2019). Chemistry is integral to everyone's life, influencing every facet of our existence and ensuring our safety. Devising methods to produce, store, and preserve food is crucial. Additionally, it plays a vital role in medicine, aiding in developing and testing drugs and understanding their interaction with the body. Moreover, the knowledge of Chemistry finds applications in numerous other fields. One way to address the challenges of learning Chemistry is by incorporating information and communication technology (ICT) into the learning process.

ICT can answer many of the problems that arise in Chemistry education, easing any awkwardness or difficulty. Information and communication technology (ICT) in education is a teaching strategy that uses ICT to enhance, augment, and promote knowledge sharing, emphasizing the importance of collaborative learning and interactive tools in improving educational outcomes (Ladjar & Susanti, 2024). ICT integration can improve the quality of learning (Kurniawan et al., 2024). The sustainability of education enhanced by ICT involves utilizing ICT in learning and teaching endeavors (Hidayat et al., 2024). This application of ICT aids in supporting the processes of learning and teaching, refining delivery methods, and optimizing design aspects to enrich knowledge acquisition. Incorporating ICT into education can enhance student learning and improve instructional methods. ICT is becoming widely integrated into teaching and learning processes, yet several elements that can affect this integration are effectiveness (Hassan et al., 2024).

Utilizing ICT facilities can facilitate a better understanding of challenging concepts in Chemistry for learners. These concepts may include quantum theory, radioactivity, chemical reactions, chemical kinetics, ionization theory, electrochemistry, chemical equilibrium, atomic theory, and the nature of atoms. Despite many secondary school teachers' access to ICT equipment and facilities, their adoption in teaching science subjects, mainly Chemistry, remains low. Teachers who have access to ICT resources to achieve instructional goals in chemistry often fail to utilize them due to several factors. These include limited technical expertise and orientation in ICT usage, unreliable electricity supply in schools, insufficient maintenance of facilities, and inadequate funding from the government.

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Additionally, the absence of ICT resources in many public secondary schools in Kwara State poses a significant concern for science educators. Offa Local Government Area is one of the sixteen Local Government Areas LGAs in Kwara State. Kwara State has sixteen private secondary schools and twenty public secondary schools. Nearly all chemistry teachers in these schools are familiar with using ICT for teaching purposes. The absence of Information and Communication Technology (ICT) resources in many public secondary schools in Kwara State has significantly impacted education quality. This lack of ICT access hinders students' exposure to essential digital skills and limits their engagement with modern learning tools (Adebayo, 2022; Olalekan, 2021).

In the book "*Infrastructure and Education: Examining ICT Resources in Nigerian Schools*" Olagunju stated that inadequate infrastructure is a significant barrier to effective ICT implementation. Many schools lack facilities like computer labs, reliable electricity, and internet access, making it challenging to establish ICT programs. The issue is even more pronounced in rural areas where basic infrastructure is often deficient (Adebayo, 2022). In addition to infrastructure, schools with computer labs typically face equipment challenges, including outdated devices, a shortage of computers, and frequent technical issues, forcing students to share computers and limiting their hands-on experience (Akinyele, 2020).

Moreover, there is a shortage of skilled ICT teachers in Kwara State. Many teachers lack training in digital literacy and ICT curriculum delivery, reducing students' exposure to technology-related subjects (Olalekan, 2021). This shortage of qualified educators has led to students lacking consistent digital literacy skills, which is crucial in today's technologically driven world (Akinyele, 2020). Olagunju also explains that funding constraints exacerbate these challenges, as limited government funding restricts the capacity of public schools to implement ICT programs. Although some initiatives aim to improve digital literacy, they are often underfunded or sporadic, resulting in inconsistent outcomes (Adebayo, 2022). Consequently, teachers frequently rely on traditional teaching methods, which can reduce student engagement and preparedness for a digital future (Olalekan, 2021). Olagunju added that addressing these issues requires a multi-faceted approach, including increased government investment in ICT infrastructure, partnerships with private organizations for funding and equipment, and comprehensive training for teachers to integrate digital skills into their teaching methods. Such efforts could improve digital literacy among students and create a more dynamic learning environment in Kwara State's public schools (Akinyele, 2020).

However, this study aims to investigate the extent of exposure and integration of ICT in teaching Chemistry among these teachers. Therefore, the study aims to assess how Chemistry teachers in secondary schools in Offa LGA, Kwara State, use ICT tools to teach Chemistry. The main goal of this study is to determine how Chemistry teachers feel about using ICT to teach Chemistry in secondary schools. The following are the specific objectives to assess the degree to which ICT tools are available for secondary school chemistry instruction. Also, to ascertain how much Chemistry teachers use the available ICT resources when instructing Chemistry. The research questions raised to guide the study are: How available are ICT tools for teaching chemistry in senior secondary schools in Offa LGA, Kwara State? To what extent do chemistry teachers in Offa LGA, Kwara State's senior secondary schools, use the ICT tools accessible to them for teaching chemistry?

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Two hypotheses were also raised to guide the study. The first one states that there is no significant difference between the mean score of ICT tools availability in public and private secondary schools in Offa LGA, Kwara State, there is no significant difference between the mean score of Chemistry teachers on the utilization of ICT tools for teaching Chemistry in public and private senior secondary schools in Offa LGA, Kwara State.

LITERATURE REVIEW

The Technology Acceptance Model

Davis developed the Technology Acceptance Model (TAM), which has since been widely used to understand users' adoption of various technologies, including educational tools and systems (Davis, 1989). TAM posits that users' behavioral intention to use technology is determined by two primary factors: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the degree to which a user believes that technology will enhance their performance or productivity, while perceived ease of use refers to the degree to which a user believes that using the technology will be effortless and free of complexity. In assessing ICT tool usage in teaching chemistry among secondary school teachers, TAM provides a framework for understanding teachers' attitudes, perceptions, and behaviors regarding integrating technology into their teaching practices (Eze et al., 2017).

Perceived Usefulness (PU) relates to teachers' beliefs about how ICT tools contribute to their effectiveness as educators and facilitate students' learning outcomes in chemistry. Teachers are likelier to adopt ICT tools if they enhance teaching effectiveness, improve student engagement, and promote learning gains in chemistry education. For example, teachers may perceive ICT tools such as virtual reality simulations, multimedia presentations, or online resources as useful for visualizing abstract chemical concepts, conducting virtual experiments, and providing interactive learning experiences.

Perceived Ease of Use (PEOU) refers to teachers' perceptions of the simplicity and user-friendliness of ICT tools in teaching chemistry. Teachers are more likely to adopt ICT tools if they perceive them as easy to learn, navigate, and integrate into their instructional practices. Factors such as user interface design, accessibility, technical support, and training opportunities influence teachers' perceptions of ease of use. For example, teachers may be more inclined to use ICT tools that offer intuitive interfaces, clear instructions, and technical assistance to support their implementation in the classroom.

The Technology Acceptance Model (TAM) provides a valuable framework for assessing ICT tool usage in teaching chemistry among secondary school teachers. By understanding teachers' perceptions of the usefulness and ease of use of ICT tools, educational stakeholders can identify strategies to promote the adoption and integration of technology in chemistry education. By addressing teachers' concerns, providing training and support, and emphasizing the benefits of ICT tools for teaching and learning, educational policymakers and administrators can foster a culture of innovation and technology integration in secondary school chemistry classrooms.

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Classification of ICT Tools

Information and communication technology (ICT) is a broad category of technological instruments and assets that create, distribute, transfer, or exchange information. It encompasses various tools and technological resources to produce, communicate, store, manage, and distribute information. ICT involves computer technology, including hardware, peripheral devices, media, and software (Alkamel & Chouthaiwale, 2018).

ICT equipment comprises devices such as computers (both desktops and laptops), the internet, and electronic delivery systems, including radio, television, projectors, digital cameras, printers, photocopiers, Android tablets, Popplets, USB flash drives, iPods, iPads, web boards, scanners, microphones, interactive whiteboards, DVDs, CDs, flash drives, and video games, among others. Computer-based communication is incorporated into normal instructional activities in the classroom as part of integrating ICT into education (Ghaviferks & Rosdy, 2015). Information and Communication Technology (ICT) encompasses a broader scope than Information Technology (IT), despite both utilizing advancements in ICT applications.

ICT is seen as the fusion of information technology with other interconnected technologies, particularly communication technology (Tiamiyu et al., 2024). It is commonly divided into two main categories: the first involves traditional computer-based technologies, which entail activities carried out on personal computers or within home and work environments. The second category comprises digital communication technologies, which facilitate digital communication and the sharing of information among individuals and organizations. Digital communication technology is prevalent across various ICT tools, particularly in education.

Teachers have many tools to enhance the teaching and learning experience, from technological equipment to software and digital educational materials. Equipment like computers, cell phones, and televisions are platforms for running software and delivering digital educational content. Integrating these ICT tools into teaching practices enhances their utilization within the educational process. ICT has revolutionized workflows within organizations and triggered significant changes in the educational landscape, influencing student learning methodologies (Al-Rahmi et al., 2020). The researcher elaborated that at the heart of ICT lie software, hardware, networks, and media, which are predominantly employed for collecting, displaying, processing, storing, and transmitting information through various mediums such as voice, data, text, and images, along with offering additional services.

ICT tools consist of electronic tools for production and communication, electronic tools for reading and writing, electronic tools for speaking and listening, and electronic tools for assessment. E-creation tools include webcams, presentation software, web publishing platforms, and movie-making software, among other instruments used for creating, examining, and finding educational information (Abdulkareem et al., 2023). E-communication tools enable students and teachers to communicate in real time over the phone through audio conferencing, instant messaging, and email. They can also be used for delayed communication through discussion boards and text messaging on cell phones (Ehindero et al., 2024). Online forums, blogs, wikis, and e-books are a few examples of reading and writing facilitative e-tools that help with teaching and learning these skills. E-tools facilitating speaking and listening include audio and video files, podcasts, and websites

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sharing audio and video content, like YouTube. E-assessment systems archive student projects, performances, and portfolios in different media to prove their learning.

Information technology is crucial in developing software tools and programs for chemistry researchers. Gupta identified several software options available to chemists, including ChemDraw, Chemdoodle, Chemsketch, Chemwindow, Chem 3D Pro, Marvinsketch, BKChem, JChempaint, Jmol, Chemwriter, XdrawChem, ISISdraw, and Avogadro (Gupta, 2023). Additionally, the researcher emphasized the presence of ICT-based chemistry instruments such as spectrophotometers, scanning electron microscopes, flame photometers, and x-ray crystallography machines.

Integration of ICT in Education

Using computers in the classroom allows students to interact with information sources directly, evaluate learning objectives, and create engaging and enjoyable learning experiences (Hidayat et al., 2024). This implies that educational activities utilizing ICT-based learning will keep improving. ICT integration turns out to be quite advantageous for teachers as well as students. The full provision of ICT resources and tools dramatically influences the success of technology-driven teaching and learning. As a result, using technologically based tools and equipment improves learning efficiency. ICT provides support and help to teachers and students, with computers acting as essential tools for education. ICT does not replace the role of quality teachers; it is an additional supplement for teaching and learning. Information and Communication Technology-Based Learning is advancing and integrating ICT (information and communication technology) in school educational processes (Hassan, 2024). This approach enables teachers and students to explore and enhance learning and teaching activities effectively and efficiently using the available system resources (Hidayat et al., 2024).

Utilizing technology in lessons aids students in comprehending subjects better and encourages active learning. It also empowers teachers to craft lesson plans creatively and effectively, fostering students' engagement (Aroch et al., 2024). However, nationwide infrastructure provision like computer labs and ICT equipment is crucial to ensure subject teachers can access ICT resources as required. Unfortunately, many secondary schools lack sufficient ICT facilities. Insufficient ICT equipment and limited internet access pose significant challenges for schools in rural areas regarding incorporating ICT into teaching. Technical issues such as low connectivity, virus attacks, and malfunctioning equipment hinder teachers from effectively utilizing ICT (Uyulgan et al., 2022). Developed countries acknowledge the significance of providing technical support to aid teachers in utilizing ICT in classrooms. Additionally, teachers' attitudes toward employing ICT tools play a crucial role in integrating ICT into education.

The attitude of Secondary School Teachers towards the Use of ICT

Technology-driven teaching and learning are more effective than traditional classroom techniques (Baneres et al.,2019). This is attributable to using ICT tools and equipment to provide a stimulating learning environment for teachers and students. Furthermore, ICT enhances classroom management by fostering well-behaved and focused students (Gabby

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et al., 2022). It also promotes creativity and imagination among students as their understanding broadens. Many educators know the advantages of integrating ICT into their lessons and have a positive outlook. Certain teachers exhibit reluctance towards incorporating ICT tools into their teaching methodologies due to several factors, including limited expertise in ICT usage, insufficient availability of ICT tools and facilities within schools, lack of technical skills, and unreliable power supply, among other reasons (Yusuf et al., 2013). The competence of science teachers in using ICT tools and how their usage can be enhanced and sustained in teaching chemistry in Ghana. The study confirms that science teachers can use ICT for teaching and learning, but overall usage remains low, especially in chemistry classes (Bayuo et al., 2022). Students' perceptions of how e-learning resources and technology impact their learning in chemistry, the study concluded that e-resources and technology positively impacted students' chemistry learning by making the subject more interactive and engaging.

The management, use, and accessibility of ICT resources for English language teaching in Kaduna State, Nigeria secondary schools. The study conclusions showed that secondary schools in Kaduna lack ICT resources because the majority of the schools visited had relatively few of these resources (Yusuf et al., 2013). Furthermore, given that the administration of these facilities necessitates ongoing training, it was discovered that most teachers lacked the necessary skills to operate them. The development of prospective chemistry teachers' attitudes and self-efficacy regarding the use of ICT in education, particularly in teaching chemistry, the study emphasized the impact of seminars on the use of ICT in science education (Krause et al., 2017). According to the Akingbade investigation, secondary school students in Ekiti State, Nigeria, had different perceptions about the availability and use of information and communication technology (ICT) in science lessons (Akingbade, 2013). While most schools have computers, other ICT equipment was absent in Ekiti State. Additionally, there was no statistically significant difference in the availability of ICT facilities between private and public secondary schools, and students in private schools had greater exposure to ICT than their counterparts in public schools.

The availability of standard educational information communications technologies (ICTs) in secondary schools using a high school in Kwekwe, Zimbabwe, as a case study. The researcher evaluated whether teachers and students use the available ICTs, looking at usage activities like lesson preparation, lesson delivery, assignment issues, research, and communications (Mavellas et al., 2016). The researchers concluded that ICT resources are not available at the school, and in most secondary schools where they were available, they were not adequately utilized. Describes action research on teacher education aiming to innovate a course on using modern ICT in science education (Krause et al., 2019).

METHODS

The study adopted descriptive survey research. The population for the study comprised all the Chemistry teachers in public and private secondary schools in Kwara State. The population for the study was comprised of all the chemistry teachers in Offa LGA, Kwara State. The study sample consisted of twenty-one chemistry teachers from sixteen public and five private senior secondary schools in Offa LGA, Kwara State. A purposive sampling

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technique was used since only the schools with qualified Chemistry teachers were involved in the study.

A self-design questionnaire titled Chemistry Teachers ICT Assessment Questionnaire (CTICTAQ), Section A of the instrument, sought demographic data of the respondents such as age, sex, teaching experience, and qualification. Section B of the instrument was structured on a two-point rating scale of available and functioning and not available to determine the availability of ICT tools. Section C of the instrument contains ten (10) items on four-point Likert scales of strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD), which were later transformed to the level of utilization on SPSS package to determine teachers' utilization of ICT tools in teaching chemistry.

The instrument was validated by expert Test and Measurement of Al-Hikmah University Ilorin. The corrections and suggestions adequately affected the instrument. A pilot test was conducted on twenty Chemistry teachers from secondary schools in Ilorin West LGA of Kwara State, which is outside the locale scope of this study. The instrument was administered to the teachers using the test and retest method within two weeks. The result of the pilot test was used to determine the reliability coefficient of 0.73 using Parson's product-moment correlation coefficient (PPMC). Hence, the instrument was considered reliable for the study. The researcher visited all the schools involved to administer the questionnaire to chemistry teachers and administered the questionnaire to twenty-one respondents. Data collected were analyzed using descriptive and inferential statistics. Frequency counts and simple percentages were used to analyze the two research questions, while the two hypotheses were analyzed using a t-test at a 0.05 significance level.

RESULTS AND DISCUSSION

Frequency and Percentage of ICT Tools in Secondary Schools in Offa LGA

This section represents the analysis of the data collected. The use of ICT tools for teaching Chemistry in Senior Secondary Schools in Offa LGA, Kwara State, is indicated in **Table 1** below.

Table 1. Frequency and percentage distribution showing the availability of ICT tools in senior secondary schools in Offa LGA, Kwara State

No	ICT	Frequency and Percentage (%)	
		Available	Not Available
1	Internet	17(81)	4(19)
2	Multimedia projector	4(19)	17(81)
3	Interactive board	3(14.3)	18(85.7)
4	Computers	21(100)	
5	Interactive Radio	6(28.6)	15(71.4)
6	Teleconferencing		21(100)
7	Audio Tape	6(28.6)	15(71.4)
8	Photocopiers	20(95.2)	1(4.8)
9	Printer	19(90.5)	2(9.5)
10	Ipad	13(61.9)	8(38.1)
11	DVD and VCD	9(42.9)	12(57.1)
12	Television	13(61.9)	8(38.1)

Source: Research, 2024

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Table 1 shows that the computer is the only available ICT tool in all the schools in Offa LGA. Teleconferencing systems are not available in any schools in Offa LGA. However, printers and photocopiers are available in almost all the schools, while the availability of other ICT facilities is moderate. Most required ICT resources are unavailable or insufficient, and the few available resources are underutilized (Mavellas et al., 2015). These may be linked to factors such as poor funding by the government for the school and lack of technical know-how, among others. Chemistry teachers' utilization of ICT tools for teaching Chemistry in Senior Secondary Schools in Offa LGA, Kwara State were ably represented in **Table 2**.

Table 2. ICT Tools utilization by chemistry teachers in Offa LGA, Kwara State

Score	Frequency	Percentage (%)	Level
10-20	2	9.5	Lowly Utilized
21-30	10	47.6	Moderately Utilized
30-40	9	42.9	Highly Utilized
Total	21	100.0	

Source: Research, 2024

Table 2 shows that ICT tools are moderately and highly utilized by chemistry teachers in Offa LGA because 19 chemistry teachers out of 21 make use of available ICT tools. This shows that ICT tools have been employed by many secondary school teachers in Offa LGA, although the full adoption has not yet been achieved. This could be due to various factors, such as cost-related, technological-related, environmental factors, and so on. Science teachers are competent in using ICT tools for teaching chemistry in Senior High Schools in Ghana (Bayuo et al., 2022). Prospective teachers' attitudes towards using ICT for teaching chemistry are relatively stable; the researcher suggested that the positive attitude could be supported and improved if the prospective teachers attend educational ICT seminars (Krause et al., 2017).

Availability and Utilization of ICT Tools by Chemistry Teachers

Hypothesis 1 H_O1 testing shows no significant difference between the mean score of ICT tools availability in public and private secondary schools in Offa LGA, Kwara State. The results related to data processing on differences in ICT availability in public and private schools can be seen in **Table 3**.

Table 3. Significant difference in ICT tools availability by chemistry teachers in public and private senior secondary schools in Offa.

Group	N	Mean	SD	Df	t-cal	t-crit. Decision
Private	5	28.600	7.403	19	-1.313	0.205 Accepted
Public	16	29.500	6.693			

Source: Research, 2024

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Table 3 shows no significant difference between the mean score of ICT tools availability in public and private schools. This does not agree with the previous study that revealed that the number of available ICT resources in private schools exceeds that of public secondary schools (Ogundile et al., 2019). The researcher identified factors for ICT adoption in private schools as infrastructural factors and support factors, among others.

Hypothesis 2 H_O2 testing found no significant difference between the mean scores of Chemistry teachers on the utilization of ICT tools for teaching Chemistry in public and private senior secondary schools in Offa LGA, Kwara State. The hypothesis is accepted, and the result of this hypothesis testing can be seen in **Table 4**.

Table 4. ICT Tools Utilization by Chemistry Teachers in Public and Private Secondary Schools in Offa LGA, Kwara State

Group	N	Mean	SD	Df	t-cal	t-critical	t-crit. Decision
Private	5	18.40	3.51				
				19	-0.243	0.816	Accepted
Public	16	20.13	2.25				

Source: Research, 2024

Table 4 shows no significant difference in the utilization of ICT tools by public and private secondary school teachers. School type does not influence the level of ICT tools utilization by chemistry teachers (Nwankwo et al., 2024). Identified factors responsible for the poor utilization of ICT tools by teachers in public secondary schools are poor ICT literacy by the teachers, inadequate funding of ICT education, poor implementation of government policies on ICT, poor network coverage, etcetera (Bolaji & Jimoh, 2023).

Discussion

The following general questions, research questions, and hypotheses were used to discuss the study's findings regarding the availability of ICT tools in secondary public and private schools. The results showed that every other ICT tool identified is not adequately available except for computers found in most schools. This is consistent with previous observations that the computer is the most accessible ICT resource in classrooms (Akingbade, 2013). Considering utilization, most chemistry teachers employ ICT resources to teach chemistry. This contradicts the study's findings by Yusuf et al., which found inadequate use of the few available ICT resources for educational purposes (Yusuf et al., 2013). However, the main obstacles to using ICT tools to teach chemistry in secondary schools are a lack of computer-literate teachers, the high cost of buying computers, inadequate facilities to support the use of ICT, the exclusion of ICT programs from teacher training programs, and a lack of funding. This is consistent with the findings of (Mavellas et al., 2016), who noted that inadequate school finance was one of the issues related to using ICT tools. Given that teachers are increasingly adopting a positive attitude toward integrating ICT tools in teaching and learning due to some of the perceived benefits, the result is that there is no discernible difference in the availability of ICT facilities in public and private secondary schools, which is very expected.

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CONCLUSION

The findings from the study suggest that secondary schools in Offa LGA, Kwara State, have access to ICT resources for instruction. If not handled properly, factors like low funding, high costs, poor internet connectivity, a lack of basic infrastructure, a lack of technical support staff, a lack of skills, and the teacher factor could all impact the use of ICT in chemistry teaching. Science lessons are more accessible to teach and more engaging when ICT is used in the classroom. Students' performance in science is improved when ICT is used effectively in chemistry instruction. This leads to more effective teaching and learning. Students' performance in science is improved when ICT is used effectively in chemistry instruction. This leads to more effective teaching and learning.

Based on the study's conclusion, it was recommended that the government should offer more ICT facilities to public secondary schools, and private school owners and proprietors should provide ICT tools for their institutions. Additionally, teachers should be required to use the ICT resources in their instruction to fully benefit from ICT in the teaching-learning process. Also, chemistry teachers should be provided free access to ICT materials. The government should provide schools with more funding to install the ICT infrastructure for students in the classroom. Lastly, more ICT tool training for chemistry teachers is required. The findings of this study on the availability and utilization of ICT tools for teaching chemistry in secondary schools have several implications, which include:

The government should prioritize funding and policy-making to ensure adequate provision of ICT resources in public schools. This can bridge the gap between the current minimal availability and the optimal resources needed for effective teaching. Private school owners should be encouraged and perhaps incentivized to invest in more comprehensive ICT infrastructure to enhance the quality of education. Also, continuous professional development programs should focus on the effective integration of ICT in chemistry teaching. This can help teachers maximize the use of available resources and adopt innovative teaching methods. Regular workshops and seminars should be organized to keep chemistry teachers updated on the latest ICT tools and pedagogical strategies. By addressing these implications, stakeholders in the education sector can significantly improve the quality of chemistry education in Offa LGA, leveraging ICT to enhance teaching and learning outcomes.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article and confirms that the data and content are free from plagiarism.

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