



Exploring Students' Views of the Opportunities and Obstacles of utilizing Digital Technologies for Chemistry Instruction in Ekiti State

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Abstract

This paper investigated the perceptions of students' on the opportunities and obstacles of utilizing digital technologies for chemistry instruction in Ekiti State. A descriptive survey approach was employed, involving the selection of 12 schools across 6 Local Government Areas, from which 246 SS2 Chemistry students were sampled using a multi-stage procedure. To achieve its aim, the study addressed four research questions. Data collection was conducted using a validated questionnaire titled "Questionnaire on Challenges and Prospects of Digital Technologies" (QCPDT). The instrument was developed by the researcher based on literature and was not adopted or adapted from any existing instrument. It was reviewed by three experts: two in Chemistry Education and one in Test and Measurement, and their corrections were incorporated. Data analysis involved descriptive statistics (mean and standard deviation) and an independent samples t-test. Significance was set at the 0.05 level. The findings revealed that the availability of digital tools for chemistry instruction was low, as indicated by an grand mean of 1.93. Students faced significant obstacles, including lack of electricity, poor internet, and insufficient devices, with an grand mean of 2.88. Despite these obstacles, students held positive perceptions of the opportunities presented by digital devices, with an grand mean of 2.87, and their overall perception was also positive, with an grand mean of 2.82. These findings reveal that students understand the value of using digital tools and resources in learning chemistry, but the current infrastructure is not conducive to effective use. From these results, the study recommends that the government provide adequate technological tools, reliable electricity, and internet connectivity to secondary schools. Chemistry teachers should also be trained through workshops and seminars on the use of digital technologies for teaching and learning chemistry.

Keywords: Digital technologies, chemistry learning, students' perception, Ekiti State

Introduction

Science education is essential for equipping students for careers that drive national growth and development.. Chemistry is one of the basic sciences that is highly relevant to technological breakthroughs and national development. Its applications extend to areas such as healthcare, industry, as well as environmental protection. Despite its importance, learner achievement in secondary schools in Nigeria has remained consistently very poor for a long time. This poor achievement has been attributed to abstract concepts in chemistry, poor teaching materials, teacher-centred teaching, and lack of student participation (Oladejo, Ademola, Ayanwale & Tobi, 2023). There are a number of challenging chemistry

topics for students. These include atomic structure, molecular interactions, benzene, nuclear chemistry and chemical equilibrium (Oladejo, Okebukola, Olateju, Akinola, Ebisin & Dansu, 2022). These are the same topics that were recorded as being challenging by both the teacher and the learner by Oladejo, Ademola and Ayanwale (2023). These ideas are complex, so many students become negative to chemistry and don't go into science careers.

To address these challenges, the integration of digital technologies into chemistry teaching has been increasing. These technologies include computers, tablets, smartphones, and interactive whiteboards. They offer interactive and engaging learning

experiences such as simulations, virtual laboratories, and 3D visualization of molecular structures (Ayoyinka, Salaudeen & Akinwande, 2025). Several studies have shown that technology-mediated instruction, simulated laboratory experiences, and intelligent tutoring systems have positive effects on students' learning outcomes, motivation, and understanding of challenging chemistry concepts (Ekundayo, 2022; Ayoyinka, Salaudeen & Akinwande, 2025). Virtual laboratories also enable safe experimentation when physical laboratories are unavailable (Oladejo & Ebisin, 2021). In addition, Augmented Reality (AR) applications and the Culturo-Techno-Contextual Approach (CTCA) have both been found to enhance student engagement and meaningful learning (Onowugbeda et al., 2022).

However, despite these benefits, significant problems hinder the effective use of digital devices in Nigerian schools. These include poor infrastructure such as electricity and internet connectivity, insufficient devices, high costs, limited teacher competence in ICT integration, and lack of technical support (Nwafor, Ibe & Muoneke, 2022; Ayoyinka, Salaudeen & Akinwande, 2025). Poor infrastructure and lack of comprehensive teacher training are the major barriers limiting ICT use in Nigerian schools. These challenges must be understood from the students' perspective.

Student perception of digital devices is a key factor that shapes how technology is used in the classroom. When students believe that technology is useful and easy to use, this directly shapes the students' behavioral intention to use technology for learning (Oladosu, Adedokun-Shittu, Sanni & Ajani, 2020). This means that even when digital tools are available, students may not use them if they do not see them as helpful or simple to operate. Oladosu et al. (2021) also found that students who find digital devices useful and easy to use are more likely to adopt them for learning. This suggests that teachers and policymakers must not only provide devices but also ensure that students understand their value. Positive perceptions also lead to increased involvement, improved understanding, self-paced learning, and better readiness for a technology-driven world (Ayoyinka, Salaudeen & Akinwande, 2025). Therefore, understanding students' perceptions is essential for designing effective strategies to integrate digital tools into chemistry education.

Research has also shown that students' perception and achievement can be influenced by

school type and gender. Regarding school type, Famuwagun and Ojobola (2021) reported that learners in private schools perform better than those in public schools because these institutions have better infrastructure and learning resources. Regarding gender, however, Oladosu et al. (2021) and Oladejo, Ademola, Ayanwale and Tobi (2023) showed that the two gender groups did not differ significantly in their perception of ICT or in the difficulty they experience in learning chemistry. This suggests that gender is not a major factor influencing students' perception of digital tools. In addition, computer-assisted instruction (CAI) and animation have been found to enhance students' achievement in chemistry (Haruna & Ambode, 2024; Ayoyinka, Salaudeen & Akinwande, 2025). These factors must be considered when examining students' perceptions.

Despite attempts by the Ekiti State government to integrate ICT into secondary education, the actual use of digital tools for chemistry instruction remains limited. Studies conducted so far have focused on ICT availability rather than on students' perceptions of the problems and opportunities of using ICT for chemistry learning. Understanding these perceptions is important for creating effective strategies to improve technology integration. Consequently, this study examines how students perceive the difficulties and opportunities associated with using digital tools for chemistry instruction in senior secondary schools in Ekiti State.

Research Questions

The following research questions guided the study:

1. How available are digital tools for chemistry instruction within senior secondary schools in Ekiti State?
2. What are the obstacles students encounter when utilizing digital tools for chemistry studies in Ekiti State?
3. What are the potential benefits of using digital tools for chemistry learning in Ekiti State?
4. What are the general attitude of senior secondary learners in Ekiti State toward using digital devices for chemistry education?

Methodology

A descriptive survey approach was employed in this study. This design was suitable because the study aimed to describe students' perceptions of digital tools for chemistry learning as they exist naturally, without manipulating any variables. The survey

method allowed data to be collected from a large sample of SS2 Chemistry students across different schools in Ekiti State, thereby allowing the results to be applied to the larger population.

The study was conducted in Ekiti State, Nigeria, which comprises 16 Local Government Areas across three Senatorial Districts. The study population comprised all SS2 Chemistry students enrolled in public and private secondary schools across the State. According to the 2023/2024 Annual School Census Report from the Ekiti State Ministry of Education, the total enrolment in Senior Secondary Schools across the State was 69,528 students (34,298 males and 35,230 females). This comprised 60,808 students in public schools (30,161 males and 30,647 females) and 8,720 students in private schools (4,137 males and 4,583 females).

From this total enrolment, the population of SS2 Chemistry students was determined to be 17,291. This figure represents 24.9% of the total SSS enrolment, which is consistent with the proportion of SS2 students offering Chemistry in secondary schools across the State.

The sample size of 246 was obtained from Krejcie and Morgan's (1970) table, which indicates

that 246 respondents are adequate for a population of about 17,000, based on a 95% confidence level and a 5% margin of error.

A multi-stage sampling procedure was used to select the sample. In the first stage, two Local Government Areas were purposively selected from each of the three Senatorial Districts, giving a total of six LGAs: Ado and Ijero (Ekiti Central), Ikere and Ise/Orun (Ekiti South), and Oye and Moba (Ekiti North). In the second stage, one public and one private secondary school were randomly selected from each of the six LGAs using a simple random technique (balloting without replacement). This resulted in a total of 12 schools (6 public and 6 private). At the third stage, students were selected from the sampled schools through a simple random sampling technique. In schools where the SS2 Chemistry class had more than 25 students, 25 students were selected by balloting. In schools where the class had fewer than 25 students, all students were included. This process yielded a total sample of 246 students. The sample distribution by gender and school type is shown in Table 1 below.

Table 1: Sample Distribution by Gender and School Type

School Type	Male	Female	Total
Public	62	73	135
Private	48	63	111
Total	110	136	246

Table 2: Respondents' Demographic Characteristics

Variable	Category	Frequency	Percentage (%)
Age Group	13–14 years	68	27.6
	15–16 years	112	45.5
	17 years and above	66	26.8
Gender	Male	110	44.7
	Female	136	55.3
School Type	Public	135	54.9
	Private	111	45.1

The majority of respondents (45.5%) were aged 15–16 years. Female students (55.3%) were more represented than male students (44.7%), and

public school students (54.9%) were more represented than private school students (45.1%).

Data were collected using a structured questionnaire titled "Questionnaire on Challenges and

Prospects of Digital Technologies" (QCPDT). The instrument was developed by the researcher based on literature and was not adopted or adapted from any existing instrument. It contained five sections (A–E), with each section containing eight items rated using a four-point Likert-type scale with response options from Strongly Agree to Strongly Disagree. Three experts participated in the validation of the instrument, two in Chemistry Education and one in Test and Measurement who made corrections that were incorporated. The consistency was assessed using data obtained from a pilot study with thirty SS2 Chemistry students from two schools not included in the main study. The pilot test produced a Cronbach alpha reliability index of 0.82, which confirmed that the instrument was reliable.

A formal letter of introduction issued by the Department of Science Education, Federal University Oye-Ekiti, was presented to the Ekiti State Ministry of Education. The Ministry approved the request and

issued a letter of authorization to the researcher. This letter was presented to the principals of the 12 selected schools, who then granted permission for the researcher to administer the questionnaire to their students. The researcher, assisted by the classroom teachers, distributed the questionnaire to students during their regular chemistry periods, and all completed copies were retrieved immediately afterward. The entire data collection process spanned approximately four weeks.

Mean and standard deviation were used to analyse the research questions. Differences in respondents' perceptions based on gender and school type were examined using the independent-samples t-test. The decision criterion for statistical significance was set at 0.05. A mean of 2.50 or higher indicated positive (agreed), whereas a mean below 2.50 indicated as negative (disagreed). All ethical guidelines were adhered to, including informed consent, confidentiality, and voluntary participation.

Results

Analysis of Research Questions

Research Question 1: How available are digital tools for chemistry instruction within senior secondary schools in Ekiti State?

Table 3 : mean and SD on Availability of Digital Tools for Chemistry Instruction

S/N	Item	Mean	Std. Dev.	Remark
1	My school has computers available for chemistry learning.	2.07	0.95	Low Extent
2	My school has projectors used for chemistry lessons.	1.88	0.83	Low Extent
3	My school has interactive whiteboards for chemistry teaching.	1.76	0.73	Low Extent
4	My school has a functional computer laboratory.	2.10	0.93	Low Extent
5	The digital devices in my school are in good working condition.	1.88	0.83	Low Extent
6	There is internet connectivity available in my school.	2.12	0.94	Low Extent
7	I have access to digital devices at home for chemistry learning.	1.71	0.77	Low Extent
8	Students in my school have access to smartphones for learning chemistry.	1.93	0.81	Low Extent
Grand mean		1.93		Low Extent

The Grand mean score of 1.93 indicates that the overall availability of digital devices for chemistry learning in Ekiti State is low. Internet connectivity

(2.12) had the highest mean score, while access to devices at home (1.71) had the lowest, suggesting significant infrastructural deficits in schools.

Research Question 2: What obstacles do students encounter when utilizing digital tools for chemistry studies in Ekiti State?

Table 4: Mean and SD on Student Challenges with Digital Tools in Chemistry Studies

S/N	Item	Mean	Std. Dev.	Remark
1	Lack of electricity makes it difficult to use digital devices for chemistry learning.	3.00	0.98	Agree
2	Internet connectivity problems affect my ability to use digital tools when learning Chemistry.	2.98	0.96	Agree
3	My school does not have enough digital devices for all students.	2.95	0.94	Agree
4	Teachers do not use digital devices during chemistry lessons.	2.85	0.98	Agree
5	I lack the skills to use digital devices for chemistry learning.	2.78	0.99	Agree
6	Digital devices are too expensive for me to afford.	2.95	0.94	Agree
7	There is no technical support available when digital devices fail.	2.80	0.98	Agree
8	My teachers do not know how to use digital devices for teaching chemistry.	2.73	0.98	Agree
Grand Mean		2.88		Agree

The Grand mean of 2.88 reveals that students agree they face significant challenges in using digital devices. Lack of electricity (3.00) was the greatest

challenge, followed by poor internet connectivity (2.98), while teachers' lack of knowledge about digital devices (2.73) was the least prominent challenge.

Research Question 3: What are the potential benefits of using digital tools for chemistry learning in Ekiti State?

Table 5: Mean and SD on Respondents' Perceptions of Digital Device Prospects

S/N	Item	Mean	Std. Dev.	Remark
1	Digital devices make chemistry learning more interesting and engaging.	2.93	0.95	Agree
2	Using digital devices helps me understand abstract chemistry concepts better.	2.85	0.95	Agree
3	Digital devices allow me to visualise molecular structures and chemical reactions.	2.90	0.98	Agree
4	Digital devices help me to learn chemistry at my own pace.	2.78	0.95	Agree
5	The use of digital devices improves my performance in chemistry.	2.83	0.96	Agree
6	Digital devices provide access to more learning resources for chemistry.	2.90	0.96	Agree
7	Using digital devices helps me to remember chemistry concepts easily.	2.73	0.94	Agree
8	Digital devices prepare me for a technology-driven world.	3.05	0.91	Agree
Grand Mean		2.87		Agree

The Grand mean score of 2.87 indicates that students agree on the positive prospects of digital devices. Students most strongly agreed that digital devices prepare them for a technology-driven world

(3.05) and make learning more engaging (2.93), though memory retention (2.73) was perceived as the least beneficial prospect.

Research Question 4: What are the general attitude of senior secondary learners in Ekiti State toward using digital devices for chemistry education.

Table 6: Mean and SD on Students' Overall Perception of Digital Device Use in Chemistry

S/N	Item	Mean	Std. Dev.	Remark
1	I enjoy using digital devices for chemistry learning.	2.83	0.96	Agree
2	Digital devices should be used more often in chemistry classes.	2.95	0.96	Agree
3	I prefer learning chemistry with digital devices than without them.	2.76	0.96	Agree
4	Using digital devices reduces my fear of learning chemistry.	2.66	0.98	Agree
5	I would recommend that other learners utilize digital devices for chemistry instruction.	2.88	0.97	Agree
6	Digital devices make chemistry learning easier for me.	2.80	0.97	Agree
7	I believe digital devices can help me to perform better in chemistry examinations.	2.78	0.95	Agree
8	Digital devices make chemistry lessons more enjoyable.	2.88	0.97	Agree
Grand Mean		2.82		Agree

The Grand mean of 2.82 indicates that students have a positive overall perception of using digital devices. Students most strongly agreed that digital devices should be used more often in chemistry classes (2.95), while reducing fear of learning chemistry (2.66) was the least agreed-upon benefit.

After obtaining the descriptive statistics, an independent-samples t-test was applied to determine whether respondents' perceptions differed across gender and school type.

Table 7: Comparative t-test Analysis of Student Perceptions Based on Gender and School type.

Variable	Category	N	Mean	SD	df	t-value	p-value	Decision
Gender	Male	110	2.58	0.47	244	-1.32	0.19	Not Significant
	Female	136	2.66	0.48				
School Type	Public	135	2.58	0.48	244	-1.86	0.06	Not Significant
	Private	111	2.69	0.45				

The results showed no significant difference between male and female students ($t = -1.32$, $p = 0.19$) or between public and private school students ($t = -1.86$, $p = 0.06$).

Discussions

Findings from this study showed that the availability of digital tools for the level of Chemistry instruction in senior secondary schools in Ekiti State remains low, with a overall mean of 1.93. This finding is not surprising given the state of educational infrastructure in many Nigerian secondary schools. The low availability can be explained by inadequate funding for educational technology, poor maintenance culture, and the high cost of acquiring and maintaining digital devices. Many schools prioritize other needs

such as classroom furniture and textbooks over digital tools. This finding is consistent with Nwafor, Ibe and Muoneke (2022), who documented limited ICT integration in chemistry instruction within Anambra State, and Ayoyinka, Salaudeen and Akinwande (2025), who identified inadequate infrastructure as a significant obstacle to ICT deployment across Nigerian schools. However, this finding contrasts with the report of Oladosu et al. (2021), who found that mobile ICT tools were available and being used by secondary school students in Ekiti State. This discrepancy may be attributed to the fact that Oladosu et al. (2021) focused on mobile devices owned by students personally, while the present study examined institutional provision of digital tools for chemistry instruction. This gap highlights the need to distinguish



between personal device ownership and school-provided digital resources.

The study further revealed that students face significant obstacles in using digital devices for chemistry learning, with an overall mean of 2.88. The most prominent obstacles were lack of electricity (3.00), poor internet connectivity (2.98), and insufficient devices (2.95). These obstacles can be attributed to the unreliable power supply in many parts of Nigeria, the high cost of internet data, and the inadequate number of devices available for students to share. Teachers' lack of knowledge about digital devices (2.73) was the least prominent obstacle, suggesting that while teachers may be willing to use technology, the infrastructural challenges prevent them from doing so effectively. These findings align with Nwafor, Ibe and Muoneke (2022) and Naah and Mayeem (2020), who reported electricity, internet, and teacher ICT skills as significant challenges. In contrast, Ekundayo (2022) and Haruna and Ambode (2024) found that when computer-assisted instruction was successfully implemented, students' achievement improved significantly, suggesting that the obstacles identified in this study are not insurmountable if proper infrastructure is provided. This contrast creates a gap between the potential of digital tools and the current reality in Ekiti State secondary schools.

Despite these obstacles, students held positive perceptions of the prospects of digital devices for chemistry learning, with an overall mean of 2.87. Students most strongly agreed that digital tools prepare them for a technology-driven world (3.05) and make learning more engaging (2.93). This positive perception can be explained by the fact that students are digital natives who are exposed to technology in their daily lives and recognize its value for their future careers. They may also find traditional chalk-and-talk methods less engaging and see digital tools as a way to make chemistry more interesting. This finding is consistent with Oladosu et al. (2021) and Adefuye et al. (2023), who observed favourable perception towards the use of digital tools among secondary school students. However, it contrasts with the findings of Yesgat, Alemayehu and Mulugeta (2022), who noted that some students experience anxiety and resistance when using virtual laboratories due to lack of familiarity. This suggests that while students generally hold positive perceptions, some may need additional support and exposure to overcome their fears.

The overall perception of students toward using digital tools for chemistry education was positive, with an overall mean of 2.82. Students strongly agreed that digital tools should be used more often in chemistry classes (2.95) and that they make chemistry lessons more enjoyable (2.88). This positive attitude can be attributed to students' desire for more interactive and engaging learning experiences. It may also reflect their awareness that digital skills are essential for success in the modern world. This finding aligns with Oladosu et al. (2021) and Adefuye et al. (2023). However, the finding contrasts with the low availability of digital tools (1.93), revealing a clear gap between students' positive attitudes and the reality of what is available in their schools. This gap highlights the need for systemic interventions to provide the infrastructure and resources that match students' readiness to use technology.

Finally, the findings indicated that students' perceptions did not differ significantly across gender groups. This implies that students of both sexes, as well as those attending public and private schools, share similar views about digital tools for chemistry learning. This may be because both genders and both school types face similar infrastructural and resource challenges in Ekiti State. This finding is consistent with Oladosu et al. (2021) and Oladejo, Ademola, Ayanwale and Tobi (2023), who found no significant gender differences in ICT perception. However, it contrasts with According to Famuwagun and Ojobola (2021) who stated that the private school students achieved higher performance than the public school students because of the better infrastructure and resources in the private schools. The difference may be linked to the fact that the present study focused on perceptions and not achievement and the various challenges encountered by public and private schools in Ekiti State may be similar with regards to the provision of digital tools for chemistry instruction.

In summary, students' perception are positive towards digital tools used as learning tools for chemistry, but students' access to these tools is low, and there are significant obstacles. The results point to the need for more comprehensive interventions that will facilitate the gap between students' positive attitudes and the reality of learning environment, as infrastructure, teacher training, and technical support are also needed.



Conclusion

The investigation revealed that availability of technological resources for chemistry instruction within Ekiti State's senior secondary institutions is inadequate. The students acknowledged difficulties/challenges such as; power failures, inadequate internet connectivity and fewer devices. Students' attitudes towards the future of using digital devices are positive and they are ready to accept the digital devices in learning. There were no significant differences between the genders or school types. This study highlights the importance of implementing system-level interventions to close the gap between students' perceptions of positive outcomes and the access to and use of digital devices in the chemistry classroom.

Recommendations

The above findings lead to the following recommendations:

1. Provision of Digital Devices: The government should supply secondary schools with adequate digital devices (computers, projectors, interactive whiteboard etc) to promote effective Chemistry learning in secondary schools in Ekiti State. This should be achieved by a targeted investment in education technology, and by collaboration with private organisations in the context of corporate social responsibility initiatives. It is important that the provision is phased in starting with schools with the largest numbers of pupils.
2. Reliable Electricity and Internet Supply: Schools should have a reliable supply of electricity and Internet connection to facilitate effective use of digital devices. This can be done by installing solar panels and inverters in schools, collaborating with telecommunication companies to provide schools with internet access at a discounted price, and equipping each school with a standby generator to power the school during chemistry lessons.
3. Teacher Training: Teacher workshop/seminar on the effective use of digital tools in teaching chemistry. Training sessions should be quarterly and practical and teachers should be given an opportunity to put into practice and use simulations, virtual lab and interactive whiteboard. The government should also

collaborate with universities to create ongoing professional development programs for integration of ICTs in science education.

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