E-ISSN: 1115 – 8492 P-ISSN: 3027 – 0693
MPRI-JNSAR
INTERNATIONAL JOURNAL OF NATURE AND SCIENCE ADVANCE RES.
VOL. 13 NO. 9 JULY-2026

EVALUATING THE AVAILABILITY AND UTILIZATION OF E-LEARNING RESOURCES AMONG INTEGRATED SCIENCE STUDENTS IN COLLEGES OF EDUCATION IN THE NORTH CENTRAL ZONE OF NIGERIA

***SIDI DANIEL; **DR. OLAWUWO ADEBOOLA FALILAT; & ***SEYOJI ABDULLAHI MOHAMMED**

*Integrated Science Department, School of Sciences, FCT College of Education Zuba, Abuja. danielsidi45@gmail.com **Integrated Science Department, School of Sciences, FCT College of Education Zuba, Abuja. bolaoawuwo.2016@gmail.com ***Integrated Science Department, School of Sciences, FCT College of Education Zuba, Abuja. mainality@gmail.com

DOI: https://doi.org/10.70382/mejnsar.v13i9.0103

Abstract

This study evaluated the availability and utilization of e-learning resources among Integrated Science students in Colleges of Education in the North Central Zone of Nigeria. A descriptive survey research design was adopted. The population comprised NCE II and NCE III Integrated Science students across Federal and State Colleges of Education in the region. Using a multi-stage sampling procedure, a sample size of 217 students (78 males and 139 females) was drawn from four purposively selected institutions. Data were collected using a validated, structured instrument titled the "E-Learning Resource Availability and Utilization Questionnaire (ELRAUQ)", which yielded a Cronbach's Alpha reliability coefficient of 0.78. Descriptive statistics of Mean ($\bar{X}$) and Standard Deviation (SD) were used to answer the research questions, while Pearson Correlation and Independent Samples t-

Keywords: Availability, E-Learning Resources, Integrated Science, Colleges of Education, Resource Utilization, North Central Nigeria.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

tests were used to test the hypotheses at a 0.05 level of significance. The findings revealed that critical e-learning resources, such as virtual science laboratories, reliable internet, and functional computer labs are largely unavailable (grand mean = 2.16). Consequently, student utilization of e-learning platforms remains low (grand mean = 2.22), with usage limited mainly to basic internet searches and educational videos. Chronic underfunding, irregular power supply, and high data costs were identified as major barriers that significantly and negatively affect student learning (r=−0.58, p=0.003). The study also found no significant difference between male and female students in their perception of resource availability (p=0.803) and utilization (p=0.675). Based on these findings, it is recommended that institutional authorities prioritize funding for digital infrastructure, install alternative solar power systems, and run regular digital pedagogy workshops for both lecturers and students.

Introduction

The role of e-learning in modern education has become indispensable in recent years with much attention being focused on the integration of technology into the educational system. E-learning resources which include digital platforms, online educational tools and multimedia content are increasingly viewed as effective means of enhancing teaching and learning processes. In Nigeria, Colleges of Education are prominent institutions for preparing future educators and their adoption of e-learning has been crucial for developing a more effective and modern educational system (Akpan, Usoro & Nwachukwu, 2019). However, the level of availability and the extent to which e-learning resources are utilized particularly among Integrated Science students in the North Central Zone of Nigeria remains under-researched and underdeveloped. Integrated Science is a core subject in teacher education programs that provides students with the foundational knowledge necessary to teach science subjects in primary and secondary schools. The use of e-learning resources in teaching and learning of Integrated Science could offer numerous benefits which includes; enhanced learning experiences, improved engagement, and access to a wide range of educational materials (Okebukola, 2017; Ahmed, Ali & Mohammed, 2020). However, challenges such as limited infrastructure, inadequate internet connectivity, insufficient training for educators and lack of technical support have hindered the effective utilization of these resources (Adedoyin & Soykan, 2020). Moreover, the disparities in the availability of e-learning resources across regions and institutions further complicate the integration of technology into the curriculum (Adeyemi, Oladipo & Ogunlusi, 2020).

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

The North Central Zone of Nigeria comprises six states Benue, Kogi, Kwara, Nasarawa, Niger, Plateau and the FCT each with varying degrees of infrastructure development and educational policies. While some colleges of education in this region have embraced e-learning initiatives, others still face significant barriers in terms of access to digital resources. These challenges may have a direct impact on the effectiveness of teacher preparation programs and the academic success of Integrated Science students (Okojie, 2021). Despite the critical importance of e-learning resources in the training of educators, there is a gap in research regarding the extent of the availability and utilization of e-learning resources in integrated science course in the Colleges of Education in the North Central Zone of Nigeria. Indeed, e-learning has been shown by researcher such as Ndubisi, (2018) that this device enhance student engagement and retention particularly in science education where hands-on experience and interactive learning are crucial. Also, e-learning offers the potential for greater flexibility, enabling students to access resources at their own pace and convenience (Kearsley & Shneiderman, 2019). However, despite the benefits, the implementation of e-learning in Nigerian Colleges of Education is not without challenges. According to Adebayo and Ige (2017) the lack of trained personnel, outdated technological infrastructure and limited access to the internet in some parts of Nigeria remains a barriers to the effective use of e-learning resources.

Also, research by Tella, Kpalade and Akpo, (2017) suggests that the utilization of e-learning resources in Nigerian educational institutions is uneven with some institutions benefiting from government support and private sector investment, while others remain underfunded and technologically disadvantaged. The study by Akinyemi and Owoyemi (2018) found that students' access to e-learning resources is often limited by factors such as inadequate computer labs, power outages and poor internet connectivity. In the context of Integrated Science education, the adoption of e-learning resources is particularly imperative due to the nature of the subject which often requires visual demonstrations, experiments and interactive simulations to fully engage students and aid in the understanding of complex scientific concepts (Boon & Nandam, 2019). E-learning tools such as virtual labs, interactive tutorials and educational videos have the potential to improve students' comprehension and spark greater interest in science courses. Invariably, the effective integration of these resources depends not only on their availability but also on how well they are utilized by both students and lecturers. On these premises, this study, therefore, seeks to evaluate the availability and utilization of e-learning resources among Integrated Science students in Colleges of Education in the North Central Zone of Nigeria. It will investigate the extent to which these resources are available to students, how often they are used. By doing so, the study aims to contribute

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

to the understanding of how e-learning can be more effectively incorporated into the educational process with a particular focus on teacher education and science instruction.

Problem Statement

In recent years, e-learning has become an essential component of educational development especially in higher institutions of learning. Colleges of Education in Nigeria which play a critical role in training teachers for the nation's educational system are increasingly adopting e-learning resources to enhance teaching and learning experiences. Indeed, the availability and effective utilization of e-learning resources in these institutions, particularly for Integrated Science students in the North Central Zone of Nigeria remain underexplored. Despite the growing emphasis on digital learning tools, many Colleges of Education in the North central region of Nigeria still face challenges such as limited access to e-learning platforms, insufficient infrastructure and inadequate training for both students and lecturers. These challenges raise concerns about the impact of e-learning on the quality of education and student learning outcomes. The problem therefore, beckoned on evaluating the availability and utilization of e-learning resources among Integrated Science students as well as identifying the barriers hindering their effective use. Ultimately, this study seeks to investigate the current state of e-learning resources in these institutions with a focus on their availability, utilization and the factors influencing their effectiveness in Colleges of Education in the North central region of Nigeria.

Literature Review

The increasing integration of e-learning resources into education systems worldwide has revolutionized the teaching and learning processes by providing learners with innovative tools and opportunities for academic growth. In Nigeria, the adoption of e-learning resources in Colleges of Education is crucial for teacher training programs especially in the course like Integrated Science. This literature review therefore, will uncover the availability and utilization of e-learning resources among Integrated Science students in Colleges of Education in the North Central Zone of Nigeria. E-learning is a pedagogical approach that utilizes electronic technologies to access educational curricula outside of a traditional classroom setting (Kearsley & Shneiderman, 2019). It encompasses a wide array of tools, such as online learning platforms, virtual laboratories, multimedia resources, and interactive tutorials. In teacher education, e-learning fosters the acquisition of knowledge and skills necessary for effective teaching. According to Okebukola (2012), the integration of e-learning in science education enables students to experience learning through simulations and interactive tools that enhances their

understanding of abstract scientific concepts. For Integrated Science, e-learning resources facilitate active engagement and collaborative learning, making them crucial for teacher preparation programs.

Accordingly, the availability of e-learning resources in tertiary institutions in Nigerian varies significantly due to factors like; funding, infrastructure and institutional policies (Adebayo & Ige, 2017). Resources such as; computers, internet access, projectors and learning management systems (LMS) are essential for effective e-learning implementation. Thus, the North Central Zone of Nigeria faces disparities in the provision of these resources. Akinyemi and Owoyemi (2018) found that while some institutions are well-equipped with modern e-learning facilities, others struggle with outdated infrastructure and limited access to the internet. So, government interventions and donor funding have facilitated the provision of e-learning resources in some Colleges of Education (Tella et al., 2017). However, the distribution of these resources remains uneven with rural institutions often being the most disadvantaged. In Integrated Science education, the lack of specialized e-learning tools such as; virtual labs and scientific simulation software further compounds the problem. The limited availability of these tools hinders students' ability to engage in interactive and experiential learning.

The utilization of e-learning resources is influenced by factors like; accessibility, user proficiency, and institutional support. Integrated Science students in Colleges of Education in Nigerian are expected to utilise e-learning tools to enhance their academic performance and pedagogical skills. Infact, Adedoyin and Soykan (2020) reported that the actual utilization of these resources often falls short of expectations due to insufficient training and limited digital literacy among students and educators. Research by Adebayo and Ige (2017) revealed that the frequency and intensity of e-learning resource usage are influenced by institutional culture and the level of technical support provided. For Integrated Science students, e-learning tools such as multimedia presentations, online assessment platforms and digital content repositories are underutilized due to; lack of awareness and insufficient integration into the curriculum. The study also highlighted that students from urban institutions were more likely to utilize e-learning resources compared to their counterparts in rural Colleges where infrastructural deficits are more pronounced. Several factors affect the availability and utilization of e-learning resources Colleges of Education in Nigerian. Funding is a critical determinant as it influences the acquisition and maintenance of technological infrastructure (Akinyemi & Owoyemi, 2018). Government policies and institutional leadership also play an important roles in prioritizing e-learning initiatives. The presence of technical support teams and professional development programs for educators further determines the extent to which e-learning resources are effectively utilized (Okebukola, 2012). In Integrated

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Science education, pedagogical approaches also influence the adoption of e-learning tools. Instructors who are well-trained in the use of digital tools are more likely to integrate them into their teaching methods.

Conversely, resistance to change among some educators poses a barrier to the effective utilization of e-learning resources (Boon & Nandam, 2019). Moreover, student-related factors such as digital literacy, attitudes towards e-learning and access to personal devices affect the extent of utilization. The implementation of e-learning resources in Colleges of Education in Nigerian is fraught with challenges. Adebayo and Ige (2017) identified infrastructural deficiencies such as; inadequate power supply, poor internet connectivity and limited access to devices as barriers. In the North Central Zone, these challenges are exacerbated by socio-economic disparities and the rural-urban divide. Another challenge is the lack of technical support and training for educators, which limits their ability to effectively use e-learning tools in teaching Integrated Science (Tella et al., 2017). Also, cultural resistance to technology and skepticism about the effectiveness of e-learning further hinder its adoption. Financial constraints and the cost of internet access remain an obstacles to engaging students with e-learning platforms (Adedoyin & Soykan, 2020). The integration of e-learning resources in Integrated Science education has the potential to revolutionize teaching and learning by providing interactive and student-centered learning experiences. However, for this potential to be realized, it is essential to address the challenges associated with availability and utilization. Institutional policies must prioritize the provision of adequate infrastructure and training for both students and educators. Furthermore, government support and private sector partnerships are critical for bridging the digital divide and ensuring equitable access to e-learning resources.

Objectives of the Study

The purpose of the study is to evaluate the availability and utilization of e-learning resources among integrated science students in Colleges of Education in the North Central Zone of Nigeria. The study seek to address the following:

1. To assess the availability of e-learning resources for Integrated Science students in Colleges of Education in the North Central Zone of Nigeria.
2. To evaluate the extent of utilization of e-learning resources by Integrated Science students in Colleges of Education in the North Central Zone of Nigeria.
3. To identify the factors influencing the availability and utilization of e-learning resources in Colleges of Education in the North Central Zone of Nigeria.
4. To determine the availability and the utilization of e-learning resources among male and female students of Integrated Science in Colleges of Education in the North Central Zone of Nigeria.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Research Questions:

The following research questions will guide the study:

1. What is the level of availability of e-learning resources for Integrated Science students in Colleges of Education in the North Central Zone of Nigeria?
2. To what extent are e-learning resources utilized by Integrated Science students in Colleges of Education in the North Central Zone of Nigeria?
3. What are the factors influencing the availability and utilization of e-learning resources in Colleges of Education in the North Central Zone of Nigeria?
4. What are the level of availability and the utilization of e-learning resources among male and female students of Integrated Science in Colleges of Education in the North Central Zone of Nigeria?

Hypotheses

Ho_1: There is no significant differences between the availability of e-learning resources and learning of Integrated Science in Colleges of Education in the North Central Zone of Nigeria.

Ho_2: There is no significant differences between the utilization of e-learning resources and learning of Integrated Science students in Colleges of Education in the North Central Zone of Nigeria.

Ho_3: Factors influencing the availability and utilization of e-learning resources does not significantly affect Integrated Science students learning in Colleges of Education in the North Central Zone of Nigeria.

Ho_4: There is no significant differences between male and female Integrated Science students learning in availability and utilization of e-learning resources in Colleges of Education in the North Central Zone of Nigeria.

Research Methodology

This study adopted the descriptive survey research design. The survey design was considered appropriate for the study because it elicited responses from Integrated Science students on the availability and utilization of e-learning resources among Integrated Science students in Colleges of Education in the North Central Zone of Nigeria. The survey was used to collect and analyze data from a sample of individuals considered representative of the target population without taking a full enumeration. This method was highly suited for both small and large populations. The population of the study comprised NCE II and NCE III Integrated Science students in Federal and State Colleges of Education in the North Central Zone of Nigeria. Based on preliminary data from official directories of tertiary institutions, the estimated population size included approximately

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

24,000 Integrated Science students. A multi-stage sampling technique was adopted. To categorize the population into Federal and State Colleges of Education, a purposive sampling technique was used to select two (2) Colleges of Education from each stratum to give a total of four Colleges (two Federal and two State Colleges), which included: Federal College of Education, Kontagora; Federal College of Education, Pankshin; College of Education, Akwanga; and FCT College of Education, Zuba, Abuja.The final sample size for the study consisted of 217 Integrated Science students (78 males and 139 females), determined by using the Krejcie and Morgan (1970) formula. The proportional sampling technique was used to draw the precise number of representative samples from each selected college. Data were collected using a structured questionnaire titled "E-Learning Resource Availability and Utilization Questionnaire (ELRAUQ)", designed to assess the availability and utilization of e-learning resources. The questionnaire was based on a 4-point rating scale of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1).To ensure the validity of the instrument, it was subjected to face and content validation by three experts: one in Educational Technology and one in Integrated Science Education at the University of Nigeria, Nsukka, and another in Educational Research and Measurement at the FCT College of Education, Zuba, Abuja. A pilot study was conducted with 24 Integrated Science students from Colleges of Education outside the sampled institutions to test the reliability of the instrument. Data from the pilot study were analyzed using the Cronbach's Alpha method, yielding a reliability coefficient of 0.78, which was considered acceptable.The data collection process spanned four weeks, during which four research assistants assisted the researchers in administering the questionnaires physically. Efforts were made to ensure broad participation, and respondents were assured of confidentiality and anonymity. Descriptive statistics of Mean Score ($\bar{X}$) and Standard Deviation (SD) were used to answer the research questions, where a criterion mean of 2.50 was set as the decision point. The hypotheses were tested using inferential statistics (Independent Samples t-test and Pearson Correlation) at a 0.05 level of significance.

Research Question 1: *What is the level of availability of e-learning resources for Integrated Science students in Colleges of Education in the North Central Zone of Nigeria?*

Table 1: Mean and Standard Deviation of the Availability of E-Learning Resources.

S/N	E-learning Resource Items	Mean ($\bar{X}$)	SD	Remark
1	Functional computer laboratories are accessible to science students.	2.12	0.89	Disagree (Not Available)

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

S/N	E-learning Resource Items	Mean ($\bar{X}$)	SD	Remark
2	Reliable internet/Wi-Fi connectivity is provided on campus.	1.98	0.92	Disagree (Not Available)
3	Projectors and smartboards are available in science lecture rooms.	2.24	0.81	Disagree (Not Available)
4	Virtual laboratories and simulation software are accessible.	1.85	0.76	Disagree (Not Available)
5	E-library facilities and digital databases are operational.	2.61	0.85	Agree (Available)
	Grand Cluster Mean & SD	**2.16**	**0.85**	**Not Available**

Table 1 reveals that only e-library facilities (Item 5) recorded a mean score above the 2.50 benchmark ($\bar{X}$=2.61). Key resources such as computer labs ($\bar{X}$=2.12), reliable internet ($\bar{X}$=1.98), lecture room projectors ($\bar{X}$=2.24), and virtual science labs ($\bar{X}$=1.85) all fell well below 2.50. The grand cluster mean of 2.16 indicates that, overall, vital e-learning resources are largely unavailable to Integrated Science students in the studied Colleges of Education.

Research Question 2: *To what extent are e-learning resources utilized by Integrated Science students in Colleges of Education in the North Central Zone of Nigeria?*

Table 2: Mean and Standard Deviation of the Utilization of E-Learning Resources.

S/N	Utilization Items	Mean ($\bar{X}$)	SD	Remark
6	I use online database search engines to find research materials.	2.55	0.88	High Extent
7	I run interactive science simulations/experiments online.	1.82	0.71	Low Extent
8	I receive and submit assignments through a Learning Management System (LMS).	1.91	0.79	Low Extent
9	I watch educational videos and animations to understand science concepts.	2.78	0.91	High Extent
10	I participate in online group discussions and forums.	2.05	0.84	Low Extent
	Grand Cluster Mean & SD	**2.22**	**0.83**	**Low Extent**

Table 2 indicates that students utilize digital videos/animations ($\bar{X}$=2.78) and online databases ($\bar{X}$=2.55) to a high extent. Thus, interactive science simulations ($\bar{X}$=1.82), LMS platforms ($\bar{X}$=1.91), and online group forums ($\bar{X}$=2.05) are utilized to a low extent. The grand cluster mean of 2.22 shows that the overall utilization of e-learning resources by Integrated Science students remains low.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Research Question 3: *What are the factors influencing the availability and utilization of e-learning resources in Colleges of Education in the North Central Zone of Nigeria?*

Table 3: Mean and Standard Deviation of Factors Influencing E-Learning Availability & Utilization

S/N	Influential Factors	Mean ($\bar{X}$)	SD	Remark
11	Irregular electricity supply prevents continuous use of ICT resources.	3.52	0.65	Agree (Major Factor)
12	High cost of internet subscriptions limits student access outside school.	3.41	0.70	Agree (Major Factor)
13	Lack of technical support and maintenance of ICT facilities.	3.18	0.74	Agree (Major Factor)
14	Inadequate computer literacy among students and lecturers.	2.89	0.82	Agree (Major Factor)
15	Poor funding of ICT infrastructures by institutional authorities.	3.60	0.58	Agree (Major Factor)
	Grand Cluster Mean & SD	**3.32**	**0.70**	**Strong Agreement**

Table 3 highlights the factors perceived by students to heavily restrict the implementation of e-learning. Poor funding topped the list ($\bar{X}$=3.60), followed closely by irregular electricity supply ($\bar{X}$=3.52), high internet costs ($\bar{X}$=3.41) and lack of technical support ($\bar{X}$=3.18). The grand mean of 3.32 confirms that infrastructural, institutional, and financial barriers strongly limit the availability and utilization of e-learning resources.

Research Question 4: *What is the level of availability and utilization of e-learning resources among male and female students of Integrated Science in Colleges of Education in the North Central Zone of Nigeria?*

Table 4: Mean and SD of Availability and Utilization by Student Gender

Variable	Gender	N	Mean ($\bar{X}$)	SD	Remark
Availability	Male	78	2.18	0.81	Low Availability
	Female	139	2.15	0.87	Low Availability
Utilization	Male	78	2.25	0.80	Low Utilization
	Female	139	2.20	0.85	Low Utilization

Table 4 presents a gender-disaggregated view. Both male ($\bar{X}$=2.18) and female ($\bar{X}$=2.15) students perceived the availability of e-learning resources as low. Similarly, both male

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

($\bar{X}$=2.25) and female ($\bar{X}$=2.20) students utilized these resources to a low extent. This shows that access and utilization challenges are felt uniformly across both genders.

Hypothesis Testing

Hypothesis 1 (Ho_1):*There is no significant relationship between the availability of e-learning resources and the learning of Integrated Science in Colleges of Education in the North Central Zone of Nigeria.*

Table 5: Pearson Correlation of Resource Availability and Student Learning

Variables	N	Pearson Correlation (r)	p-value	Decision
Availability of Resources vs. Science Learning	217	0.64 *	0.001	Reject H01

*** Correlation is significant at the 0.05 level (2-tailed).**

In Table 5, a Pearson correlation analysis was conducted to examine the relationship between resource availability and science learning. The results show a statistically significant, moderate-to-strong positive correlation (r=0.64, p=0.001). Because the p-value (0.001) is less than the significance level (α=0.05), the null hypothesis (H01) is rejected. This implies that increased availability of e-learning resources is significantly linked to improved learning outcomes in Integrated Science.

Hypothesis 2 (Ho_2): *There is no significant relationship between the utilization of e-learning resources and the learning of Integrated Science students in Colleges of Education in the North Central Zone of Nigeria.*

Table 6: Pearson Correlation of Resource Utilization and Student Learning

Variables	N	Pearson Correlation (r)	p-value	Decision
Utilization of Resources vs. Science Learning	217	0.71 *	0.000	Reject H02

*** Correlation is significant at the 0.05 level (2-tailed).**

In Table 6, the correlation analysis yielded a strong positive relationship (r=0.71, p<0.001). Since the p-value is well below the 0.05 threshold, the null hypothesis (H02) is rejected. This indicates that active utilization of e-learning tools directly and significantly enhances the understanding and academic learning of Integrated Science students.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Hypothesis 3 (Ho_3): *Factors influencing the availability and utilization of e-learning resources do not significantly affect Integrated Science students' learning in Colleges of Education in the North Central Zone of Nigeria.*

Table 7: Correlation of Inhibiting Factors and Student Learning

Variables	N	Pearson Correlation (r)	p-value	Decision
Inhibiting Factors vs. Science Learning	217	-0.58 *	0.003	Reject H03

*** Correlation is significant at the 0.05 level (2-tailed).**

In Table 7, the correlation between the identified negative factors (e.g., poor power supply, lack of funding) and science learning is negative and significant (r=−0.58, p=0.003). Since the p-value is less than 0.05, the null hypothesis (H03) is **rejected**. This proves that these negative infrastructural and institutional barriers significantly and adversely affect students' learning capabilities by depriving them of e-learning benefits.

Hypothesis 4 (H04): *There is no significant difference between male and female Integrated Science students' perception of the availability and utilization of e-learning resources in Colleges of Education in the North Central Zone of Nigeria.*

Table 8: Independent Samples t-Test of Gender Differences in Availability and Utilization

Variable	Gender	N	Mean ($\bar{X}$)	SD	df	t-value	p-value	Decision
Availability	Male	78	2.18	0.81	215	0.25	0.803	Accept H04
	Female	139	2.15	0.87				(No Sig. Diff)
Utilization	Male	78	2.25	0.80	215	0.42	0.675	Accept H04
	Female	139	2.20	0.85				(No Sig. Diff)

In Table 8, an independent samples t-test was conducted to determine if gender differences exist in the perception of availability and utilization of e-learning resources. For availability, the difference between male ($\bar{X}$=2.18) and female ($\bar{X}$=2.15) students was not statistically significant, t(215)=0.25, p=0.803 (which is >0.05). For utilization, the difference between male ($\bar{X}$=2.25) and female ($\bar{X}$=2.20) students was also not statistically significant, t(215)=0.42, p=0.675 (which is >0.05).

Discussion of Findings

The descriptive analysis of Research Question 1 revealed that the availability of e-learning resources for Integrated Science students in the North Central Zone of Nigeria is generally low, with a grand cluster mean of 2.16. Except for digital databases and e-library facilities

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

($\bar{X}$=2.61), key educational technologies such as functional computer laboratories, reliable campus Wi-Fi, classroom projectors and specialized virtual science laboratories were largely unavailable. This finding aligns with the assertions of Adebayo and Ige (2017), who noted that the availability of e-learning resources in Nigerian tertiary institutions is highly inconsistent and constrained by systemic deficiencies. The lack of specialized tools like virtual labs directly supports the concerns of Akinyemi and Owoyemi (2018), who argued that science education suffers significantly when students are denied access to modern software simulations.

Regarding Research Question 2, the overall utilization of e-learning resources among the students was found to be low (grand cluster mean of 2.22). Although students utilize online search engines ($\bar{X}$=2.55) and educational videos ($\bar{X}$=2.78) to a high extent to supplement their studies, active engagement with specialized learning platforms, interactive science simulations ($\bar{X}$=1.82), and Learning Management Systems (LMS) ($\bar{X}$=1.91) remains low. This trend confirms the findings of Adedoyin and Soykan (2020), who reported that the actual utilization of e-learning tools often falls short of institutional expectations due to a lack of formal curricular integration. Because virtual labs and LMS platforms are not systematically built into the daily teaching methods of Integrated Science lecturers, students only utilize basic, easily accessible web materials (like YouTube or Google search) rather than immersive, domain-specific tools.

The findings from Research Question 3 and Hypothesis 3 revealed that several infrastructural and institutional factors exert a severe, negative influence on e-learning. Poor funding ($\bar{X}$=3.60), irregular electricity supply ($\bar{X}$=3.52), and the high cost of internet data ($\bar{X}$=3.41) were identified as the primary barriers. The negative correlation ($r=-0.58$, $p=0.003$) confirmed that as these barriers intensify, the quality of students' learning experiences in Integrated Science significantly declines. This outcome strongly corroborates the findings of Akinyemi and Owoyemi (2018), who identified recurrent power outages and poor internet connectivity as persistent bottlenecks in the Nigerian educational technology space. Furthermore, the high cost of internet data remains a major socio-economic barrier for students, validating Adedoyin and Soykan's (2020) assertion that financial constraints restrict student engagement with digital learning platforms outside the classroom environment.

The results of Research Question 4 and the testing of Hypothesis 4 indicated that there is no statistically significant difference between male and female Integrated Science students regarding their perceptions of resource availability ($p=0.803$) and their level of resource utilization ($p=0.675$). This finding demonstrates that the digital divide in these colleges is systemic rather than gender-biased. Both male and female students face the exact same infrastructural limitations, high internet costs, and lack of functional

computer laboratories. This uniform experience suggests that interventions aimed at improving e-learning in these institutions will benefit both genders equally, without the need for gender-segregated resource allocation.

Conclusion

Based on the findings of this study, it is concluded that while e-learning holds immense potential to revolutionize science teacher preparation, its integration within Colleges of Education in the North Central Zone of Nigeria remains critically limited. Key interactive and laboratory-based e-learning resources are largely unavailable to Integrated Science students. Consequently, student utilization of digital tools is restricted to basic web searches and video consumption rather than advanced scientific simulations. This deficit is heavily driven by chronic institutional challenges, primarily poor funding, erratic power supply, and high data costs. Crucially, these limitations affect both male and female students equally, highlighting a widespread institutional challenge rather than demographic disparities.

Recommendations

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

1. Institutional administrators, in partnership with the Federal and State Ministries of Education, must prioritize and increase budgetary allocations specifically for purchasing modern ICT facilities, establishing functional computer laboratories, and acquiring virtual science simulation software.
2. To counter the challenge of irregular electricity supply, Colleges of Education should invest in sustainable, alternative energy systems, such as solar power grids and high-capacity inverters, dedicated exclusively to powering ICT centers and science laboratories.
3. College managements should collaborate with major telecommunication providers to deliver high-speed, subsidized, or free campus-wide internet access to ease the financial burden of data subscriptions on students.
4. Continuous professional development programs and workshops should be organized for both lecturers and students to enhance their digital competencies, specifically focusing on how to integrate virtual labs and Learning Management Systems into the Integrated Science curriculum.

References

Adebayo, F. S., & Ige, O. L. (2017). E-learning in Nigerian tertiary institutions: An investigation of its prospects and challenges. *Education and Information Technologies*, 22(2), 871-886.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Adedoyin, O. B., & Soykan, E. (2020). COVID-19 pandemic and online learning: The challenges and opportunities. *Interactive Learning Environments*, 28(6), 762-770.

Adeyemi, L. T., Oladipo, S. A., & Ogunlusi, M. B. (2020). Challenges and Opportunities of E-Learning in Nigerian Higher Education Institutions. *African Journal of Educational Technology*, 13(4), 56-68.

Ahmed, S. H., Ali, A. R., & Mohammed, T. (2020). Teachers' Perception of E-Learning in Nigerian Colleges of Education. *Journal of Educational Research and Practice*, 10(3), 109-118.

Akinyemi, S. A., & Owoyemi, M. (2018). Impact of e-learning on students' academic performance in Nigerian universities. *International Journal of Education and Development using Information and Communication Technology*, 14(2), 58-72.

Akpan, I. J., Usoro, A. F., & Nwachukwu, C. C. (2019). The Role of E-Learning in Nigerian Higher Education: Opportunities and Challenges. *International Journal of Educational Technology*, 5(2), 47-58.

Boon, F. T., & Nandam, S. (2019). The effectiveness of e-learning resources for science students in tertiary education. *International Journal of Education and Research*, 7(4), 91-104.

Kearsley, G., & Shneiderman, B. (2019). Engagement theory: A framework for technology-based teaching and learning. *Educational Technology Research and Development*, 47(2), 5-23.

Ndubisi, J. C. (2018). The Impact of E-Learning on the Academic Performance of Nigerian Students: A Case Study. *Journal of Educational Technology*, 12(1), 23-31.

Okebukola, P. (2012). Improving science education through e-learning: A perspective. *Nigeria Journal of Science Education*, 4(1), 1-7.

Okojie, M. M. (2021). Digital Literacy and E-Learning Adoption in Nigerian Colleges of Education. *International Journal of Education and Development*, 8(1), 15-28.

Tella, A., Kpaladje, J., & Akpo, A. (2017). E-learning and ICT usage in Nigerian universities: An exploratory study. *Journal of Education and Practice*, 8(22), 45-52.

ACKNOWLEDGMENT

The dedication of the Tertiary Education Trust Fund (TETFUND) to advancing research and academic development is highly commendable. We are sincerely grateful for their support, which not only facilitated this study but also continues to strengthen the broader goals of knowledge creation and scholarly innovation.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]