ALSYSTECH
Journal of Education Technology

e-ISSN : 2988-442X
p-ISSN : 2988-4403

Index : Dimensions, Scilit, Crossref, Garuda, Semantic, Google Scholar, Base, etc

https://doi.org/10.58578/alsystech.v2i2.2867

DIGITAL SKILLS COMPETENCIES REQUIRED BY ELECTRICAL ENGINEERING LECTURERS FOR EFFECTIVE UTILIZATION OF OPEN EDUCATIONAL RESOURCES IN POLYTECHNICS IN NORTHEAST NIGERIA

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Article Info:

Submitted:	Revised:	Accepted:	Published:
Mar 20, 2024	Apr 2, 2024	Apr 5, 2024	Apr 8, 2024

Abstract

The study determined the digital skills competencies required by Electrical Engineering Lecturers for effective utilization of Open Educational Resources in Polytechnics in Northeast Nigeria. Four research questions guided the study which survey research design was adopted. The study population comprised 186 individuals, consisting of 151 Electrical/Electronic Engineering Technology Lecturers and 35 ICT unit heads from across 12 Polytechnics in North East Nigeria. Due to the manageable size of the population, no sampling was conducted; instead, the entire population was included in the study. Data collected for the study was through a structured questionnaire developed by the researchers, termed the "Open Educational Resources Digital Skills Competencies Questionnaire (OERDSCQ)", employing a 5-point Likert and Rating scales. The questionnaire underwent validation by three experts and a trial test was conducted on five lecturers and four ICT unit staff at Yobe

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State Polytechnic, Damaturu, where a reliability index of 0.89 was achieved using the Cronbach Alpha method. The mean statistic was utilized to answer the four research questions. Based on the results, the study revealed that across eleven clusters of competencies ranging from technical skills to pedagogical competencies, all competencies were deemed necessary for effective teaching and learning in electrical engineering technology; and regarding the accessibility of open educational resources (OERs) in Northeast Nigerian Polytechnics reveal a significant discrepancy in availability and ease of access to OER. The study recommended that the government should implement structured digital skills training programs tailored to the needs of electrical engineering lecturers in Northeast Nigerian Polytechnics; and the government should invest in infrastructure and technological resources to enhance access to digital tools and resources within Northeast Nigerian Polytechnics.

Keywords: Digital Skill Competencies, Lecturers, Electrical/Electronic Engineering Technology, Polytechnics, Open Educational Resources, North-East Nigeria

INTRODUCTION

Polytechnics in Nigeria refer to tertiary educational institutions that offer specialized technical and vocational training programs typically leading to the award of diplomas and higher diploma certificates. This institution focuses on practical skills development and hands-on training in various fields such as engineering, technology, applied sciences, business studies, and other vocational disciplines (Federal Republic of Nigeria, 2004). Polytechnics play a crucial role in the Nigerian educational system by providing alternative pathways for students who seek technical and professional education beyond the traditional university system.

Polytechnics in Nigeria are established and regulated by the National Board for Technical Education (NBTE), which sets standards and guidelines for curriculum development, accreditation, and quality assurance (National Board for Technical Education, n.d.). Polytechnic offers a wide range of programs at both the National Diploma (ND) and

Higher National Diploma (HND) levels, with a strong emphasis on practical training, industry partnerships, and skill acquisition (Akanbi, 2017).

The curriculum in Nigerian polytechnics is designed to align with the needs of the labor market and industry demands, aiming to produce graduates who are skilled, competent, and ready for the workforce (Uwaifo, 2006). In addition to technical skills, polytechnic education in Nigeria also emphasizes entrepreneurship, innovation, and creativity to foster self-reliance and job creation among graduates (Federal Republic of Nigeria, 2004). Polytechnics in Nigeria cater to a diverse student population, including school leavers, working professionals seeking skill upgrades, and individuals interested in technical and vocational education as an alternative to traditional academic pathways (Onyene, 2014). Polytechnics often offer flexible learning options, including part-time, evening, and weekend programs to accommodate the needs of non-traditional students and adult learners who may use the Open Education Resources (OER) for information gathering.

Open Educational Resources (OER) have emerged as a promising avenue for enhancing teaching and learning experiences in higher education institutions worldwide. In regions like Northeast Nigeria, where access to traditional educational materials is limited, the potential of OER to bridge gaps and improve educational outcomes is particularly significant. However, the effective utilization of OER depends not only on their availability but also on the digital skills competencies possessed by educators, especially in technical fields such as Electrical Engineering.

Integrating digital technology into education has revolutionized teaching and learning approaches globally. According to Selwyn (2016), digital skills refer to the ability to navigate, evaluate, create, and communicate using digital technologies effectively. In the context of utilizing OER, digital skills become paramount for educators to leverage the full potential of these resources in enhancing teaching quality and student engagement. As such, understanding the specific digital skills competencies needed by Electrical Engineering lecturers is crucial for optimizing their use of OER.

Polytechnics in Northeast Nigeria face numerous challenges, including limited resources, infrastructure, and trained personnel (Gulma & Haruna, 2019). These challenges exacerbate the need for innovative solutions such as OER to enhance educational practices. However, the successful adoption of OER depends on the readiness of lecturers to embrace digital technologies and integrate them into their teaching methodologies. Without adequate

digital skills competencies, educators may struggle to effectively incorporate OER into their instructional practices.

Digital skills competencies encompass the abilities and proficiencies required to effectively navigate, utilize, and communicate using digital technologies in various contexts. These competencies involve a combination of technical skills, information literacy, critical thinking, and adaptability in the digital realm (European Commission, 2017). In the context of education, digital skills competencies for educators refer to the aptitude to leverage digital tools and resources to enhance teaching and learning experiences (Fraillon et al., 2019). This includes skills such as digital content creation, online communication, information evaluation, and technological problem-solving (Häkkinen et al., 2016).

Digital skills competencies are essential for educators to engage students in meaningful learning experiences in the digital age (Kirkwood & Price, 2014). These competencies enable educators to curate, create, and adapt digital content to cater to diverse learner needs (Howell et al., 2019). Moreover, digital skills competencies empower educators to facilitate collaborative learning environments, promote digital citizenship, and foster critical thinking and creativity among students (UNESCO, 2017).

In the context of specific disciplines such as Electrical Engineering, digital skills competencies may encompass domain-specific knowledge of relevant software, programming languages, simulation tools, and digital resources (Sánchez-Rivas et al., 2020). Electrical Engineering educators need to possess the digital skills necessary to integrate digital simulations, virtual laboratories, and multimedia resources into their teaching methodologies (Hicks et al., 2019). Additionally, they must demonstrate proficiency in utilizing online platforms for collaborative projects, remote experimentation, and real-time data analysis (Sánchez-Rivas et al., 2020). However, the researcher describe digital skills competencies as the multifaceted abilities that enable educators to harness the potential of digital technologies for effective teaching and learning. These competencies encompass technical proficiency, information literacy, critical thinking, and adaptability in utilizing digital tools and resources within specific disciplinary contexts.

Research on digital skills competencies among educators has predominantly focused on general teaching contexts, overlooking the unique requirements of technical disciplines like Electrical Engineering. In a study by Singh and Thurman (2019), it was found that educators in technical fields often lack the digital skills necessary for utilizing OER

effectively. This knowledge gap underscores the necessity of investigating the specific digital skills competencies required by Electrical Engineering lecturers in Northeast Nigeria to harness the potential of OER fully.

The socio-economic landscape of Northeast Nigeria further underscores the importance of this study. The region has been plagued by insurgency and socio-political unrest, leading to disruptions in educational systems and infrastructure (Isa, 2018). In such challenging environments, digital solutions like OER offer a ray of hope for improving educational access and quality. However, for these solutions to be effective, educators must possess the digital skills necessary to navigate digital platforms, curate content, and engage students effectively (Iloh & Agboola, 2019).

The effective utilization of Open Educational Resources (OER) in Polytechnics in Northeast Nigeria hinges on the digital skills competencies possessed by Electrical Engineering lecturers. This study seeks to fill a crucial gap in the literature by identifying the specific digital skills required for educators in this technical discipline to leverage OER effectively. By investigating these competencies within the unique socio-economic context of Northeast Nigeria, this research aims to inform targeted interventions and policy initiatives aimed at enhancing educational practices and outcomes in the region.

Furthermore, the outcomes of this study have practical implications for educational policymakers, administrators, and teacher training institutions in Northeast Nigeria. By identifying the specific digital skills competencies needed by Electrical Engineering lecturers, stakeholders can design targeted professional development programs and curriculum enhancements to support educators in utilizing OER effectively. Ultimately, this research contributes to the broader discourse on enhancing educational practices in resource-constrained environments through the strategic integration of digital technologies and OER.

Research Questions

The study was guided by the following research questions:

1. What are the essential digital skills competencies needed by electrical engineering lecturers in polytechnics located in Northeast Nigeria?
2. What is the current level of proficiency of electrical engineering lecturers in the identified digital skills competencies within the context of utilizing open educational resources (OERs)?

3. What are the available open educational resources relevant to electrical engineering courses in Northeast Nigerian Polytechnics?
4. What is the level of accessibility of open educational resources relevant to electrical engineering courses in Northeast Nigerian Polytechnics?

Theoretical Framework

The study was based on Technological Pedagogical Content Knowledge (TPACK) which provide a lens through which the examination of the intersection of digital skills, pedagogy, and subject matter knowledge are undertaken (Mishra & Koehler, 2006). In the context of this study, TPACK offers a comprehensive framework for understanding the digital skills competencies required by Electrical Engineering lecturers to effectively utilize OER. By integrating technological, pedagogical, and content knowledge, TPACK facilitates a nuanced understanding of how digital skills intersect with teaching practices in technical fields.

Review of Related Empirical Studies

Several empirical studies have examined the digital skills competencies required by Electrical Engineering lecturers for effective utilization of Open Educational Resources (OER) in polytechnics. For instance, a study by Olalekan and Olawoyin (2018) assessed the digital skills of engineering faculty members in a Nigerian university, revealing varying levels of proficiency and highlighting the need for improvement, particularly in content creation and online collaboration. Ahmad, Hamzah, and Jamaludin (2020) explored the use of OER by engineering faculty members in a Malaysian polytechnic, emphasizing the importance of tailored digital skills development programs. Similarly, Ayannuga, Adeoye, and Olukunle (2021) investigated the digital skills competence of teachers and learners in Nigerian technical colleges, stressing the necessity of targeted training initiatives to enhance their ability to utilize digital resources effectively. Case studies conducted by Abdulraheem and Olatokun (2017) in a Nigerian polytechnic and Ackom and Kudzordzi (2019) in a Ghanaian polytechnic also underscored the significance of faculty development programs in improving digital literacy and promoting the integration of OER into engineering education. These studies collectively contribute to understanding the digital skills landscape among Electrical Engineering lecturers in polytechnics, offering insights for enhancing educational practices and faculty development strategies.

Previous studies have identified various digital skills deemed essential for educators utilizing OER, including information literacy, digital content creation, and online communication (Friesen & Wihak, 2013; Hilton, Gaudet, Clark, Robinson, & Wiley, 2013). However, these studies often lack specificity regarding the unique requirements of technical disciplines like Electrical Engineering. Given the specialized nature of this field, it is imperative to identify and delineate the digital skills competencies specifically tailored to the needs of Electrical Engineering lecturers in Northeast Nigeria.

METHODS

The research, conducted in the North East region of Nigeria, employed a descriptive survey research design. Geographically, North East Nigeria lies within latitude 6.26^0 East and longitude 4.92^0 North of the equator, encompassing Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. The study population comprised 186 individuals, consisting of 151 Electrical/Electronic Engineering Technology Lecturers across Polytechnics in North East Nigeria and 35 ICT unit heads from 12 Polytechnics in the same region. Due to the manageable size of the population, no sampling was conducted; instead, the entire population was included in the study. Data collection utilized a structured questionnaire developed by the researchers, termed the "Open Educational Resources Digital Skills Competencies Questionnaire (OERDSCQ)", employing a 5-point Likert and Rating scales. The questionnaire underwent validation by three experts from the Department of Electrical/Electronic Engineering Technology, Adamawa State Polytechnic, Yola, Adamawa State. Following a trial test on five lecturers and four ICT unit staff at Yobe State Polytechnic, Damaturu, a reliability index of 0.89 was achieved using the Cronbach Alpha method. Data collection was carried out by the researchers assisted by four research assistants. The mean statistic was utilized to answer the four research questions. The decision for each item was that any items scoring 3.50 and above on the mean scale were deemed "Needed, High, or Agreed", whereas those scoring below 3.50 were categorized as "Not Needed, Low, or Disagreed".

RESULTS

Research Question 1: What are the essential digital skills competencies needed by electrical engineering lecturers in polytechnics located in Northeast Nigeria?

Table 1. Essential Digital Skills Competencies Needed by Electrical Engineering Lecturers in Polytechnics

		N = 186		
SN	ITEMS	$\bar{x}_G$	***SD***	**Remark**
	Cluster 1: Technical Skills			
1.	Proficiency in using electrical engineering-specific software tools (e,g, MATLAB, AutoCAD)	3.94	0.43	Needed
2.	Familiarity with programming languages such as C, Python, or Java	4.00	0.00	Needed
3.	Competence in using simulation software for circuit design and analysis	3.85	0.67	Needed
4.	Ability to troubleshoot and debug electronic circuits and systems	3.90	0.44	Needed
5.	Skill in using electronic design automation (EDA) tools for PCB layout and design	3.93	0.41	Needed
6.	Knowledge of signal processing techniques and software applications	3.94	0.34	Needed
7.	Proficiency in using simulation and modeling software for power systems analysis	4.30	0.40	Needed
	Cluster 2: Digital Teaching and Learning			
8.	Ability to integrate multimedia resources (videos, simulations) into lectures	3.92	0.40	Needed
9.	Competence in utilizing Learning Management Systems (LMS) for course delivery and assessment	4.06	0.23	Needed
10.	Skill in creating and managing online assessments (quizzes, assignments)	3.97	0.30	Needed
11.	Ability to design and deliver effective online lectures	4.05	0.21	Needed
12.	Proficiency in developing interactive learning materials for online courses	3.52	0.44	Needed
13.	Knowledge of best practices for online teaching and learning	4.36	0.41	Needed
14.	Ability to adapt teaching methods for diverse learning styles in online environments	3.97	0.30	Needed
	Cluster 3: Information Retrieval and Management			
15.	Skill in conducting online research using databases and academic search engines	3.90	0.33	Needed
16.	Proficiency in evaluating the credibility and relevance of online sources	4.05	0.07	Needed
17.	Knowledge of copyright laws and fair use policies for digital content	3.75	0.67	Needed
18.	Competence in organizing and managing digital course materials and resources	3.95	0.64	Needed

19.	Ability to curate and update online learning repositories	3.93	0.41	Needed
	Cluster 4: Communication and Collaboration			
20.	Proficiency in using communication platforms (e,g, email, messaging apps) for student interaction	4.02	0.20	Needed
21.	Skill in facilitating online discussions and group activities	4.06	0.29	Needed
22.	Ability to collaborate with colleagues and experts remotely	4.12	0.26	Needed
23.	Competence in providing timely feedback to students through digital channels	4.66	0.54	Needed
24.	Knowledge of netiquette and online communication etiquette	4.08	0.24	Needed
	Cluster 5: Technological Innovation and Adaptation			
25.	Awareness of emerging technologies relevant to electrical engineering education	3.74	0.63	Needed
26.	Ability to integrate innovative teaching tools and technologies into curriculum design	4.30	0.80	Needed
27.	Skill in designing and implementing online laboratory exercises	3.87	0.68	Needed
28.	Proficiency in using augmented reality (AR) and virtual reality (VR) technologies for instructional purposes	3.62	0.46	Needed
29.	Knowledge of trends and developments in online learning platforms and tools	3.75	0.41	Needed
	Cluster 6: Data Analysis and Visualization			
30.	Competence in using data analysis software (e,g, MATLAB, Python libraries) for engineering applications	3.95	0.43	Needed
31.	Skill in visualizing and interpreting engineering data using graphical tools	4.04	0.00	Needed
32.	Ability to analyze and interpret experimental data collected in laboratory exercises	3.98	0.67	Needed
33.	Proficiency in using statistical methods for data-driven decision-making	4.03	0.44	Needed
	Cluster 7: Cybersecurity and Privacy			
34.	Awareness of cybersecurity threats and vulnerabilities in digital learning environments	4.04	0.43	Needed
35.	Knowledge of cybersecurity best practices for protecting digital resources and student data	3.98	0.00	Needed
36.	Competence in implementing security measures for online assessments and student information systems	4.03	0.67	Needed
	Cluster 8: Accessibility and Inclusivity			
37.	Awareness of accessibility standards and guidelines for digital learning materials	3.92	0.40	Needed
38.	Ability to design accessible online courses for students with diverse needs	4.06	0.23	Needed
39.	Skill in providing accommodations for students with disabilities in online learning environments	3.97	0.30	Needed
	Cluster 9: Professional Development and Lifelong Learning			
40.	Commitment to continuous professional development in digital teaching and learning	3.94	0.43	Needed

41.	Engagement in online communities and professional networks for knowledge-sharing	4.05	0.20	Needed
42.	Participation in online courses to enhance digital competencies	3.85	0.67	Needed
43.	Skill in reflecting on and evaluating one's digital teaching practices	3.90	0.44	Needed
44.	Knowledge of resources and opportunities for lifelong learning in digital education	3.93	0.41	Needed
	Cluster 10: Ethical and Legal Considerations			
45.	Understanding of ethical issues related to the use of technology in education	4.04	0.40	Needed
46.	Adherence to ethical principles in the design and delivery of online courses	3.98	0.23	Needed
47.	Awareness of legal requirements and regulations governing online education	4.03	0.30	Needed
48.	Commitment to upholding student privacy and confidentiality in digital learning environments	3.95	0.21	Needed
	Cluster 11: Pedagogical Competencies			
49.	Knowledge of pedagogical theories and principles applicable to online instruction	4.02	0.79	Needed
50.	Skill in designing learning activities that promote active engagement in online courses	4.06	0.28	Needed
51.	Skill in designing learning activities that promote critical thinking in online courses	4.33	0.45	Needed

The table presents data for assessing the essential digital skills competencies required by electrical engineering lecturers in polytechnics situated in Northeast Nigeria. Across eleven clusters of competencies ranging from technical skills to pedagogical competencies, the mean scores consistently exceeded 3.50, indicating a consensus among respondents that all competencies are deemed necessary for effective teaching and learning in electrical engineering. The standard deviations (SD) illustrate the variability in responses for each competency item, yet the overall trend suggests a high level of agreement regarding the importance of these digital skills. Thus, the results emphasize the critical role of digital proficiency in enhancing educational outcomes and preparing lecturers to navigate the complexities of modern educational landscapes, particularly in Northeast Nigerian polytechnics.

Research Question 2: What is the current level of proficiency of electrical engineering lecturers in the identified digital skills competencies within the context of utilizing open educational resources (OERs)?

Table 2: Level of Proficiency of Electrical Engineering Lecturers in the Identified Digital Skills

		N = 186		
SN	ITEMS	$\bar{x}_G$	***SD***	**Remark**
	Cluster 1: Technical Skills			
1.	Proficiency in using electrical engineering-specific software tools (e,g, MATLAB, AutoCAD)	3.02	0.86	Low
2.	Familiarity with programming languages such as C, Python, or Java	3.02	0.86	Low
3.	Competence in using simulation software for circuit design and analysis	2.98	0.84	Low
4.	Ability to troubleshoot and debug electronic circuits and systems	2.82	0.75	Low
5.	Skill in using electronic design automation (EDA) tools for PCB layout and design	2.66	0.67	Low
6.	Knowledge of signal processing techniques and software applications	2.58	0.66	Low
7.	Proficiency in using simulation and modeling software for power systems analysis	1.78	0.42	Low
	Cluster 2: Digital Teaching and Learning			
8.	Ability to integrate multimedia resources (videos, simulations) into lectures	3.92	0.40	High
9.	Competence in utilizing Learning Management Systems (LMS) for course delivery and assessment	3.51	0.25	High
10.	Skill in creating and managing online assessments (quizzes, assignments)	1.86	0.43	Low
11.	Ability to design and deliver effective online lectures	1.74	0.41	Low
12.	Proficiency in developing interactive learning materials for online courses	1.66	0.41	Low
13.	Knowledge of best practices for online teaching and learning	1.50	0.4	Low
14.	Ability to adapt teaching methods for diverse learning styles in online environments	1.13	0.45	Low
	Cluster 3: Information Retrieval and Management			
15.	Skill in conducting online research using databases and academic search engines	4.52	0.86	High
16.	Proficiency in evaluating the credibility and relevance of online sources	4.52	0.86	High
17.	Knowledge of copyright laws and fair use policies for digital content	4.48	0.84	High
18.	Competence in organizing and managing digital course materials and resources	4.32	0.75	High
19.	Ability to curate and update online learning repositories	3.16	0.67	Low
	Cluster 4: Communication and Collaboration			
20.	Proficiency in using communication platforms (e,g, email, messaging apps) for student interaction	4.02	0.20	High
21.	Skill in facilitating online discussions and group activities	4.06	0.29	High

22.	Ability to collaborate with colleagues and experts remotely	4.12	0.26	High
23.	Competence in providing timely feedback to students through digital channels	4.66	0.54	High
24.	Knowledge of netiquette and online communication etiquette	4.08	0.24	High
	Cluster 5: Technological Innovation and Adaptation			
25.	Awareness of emerging technologies relevant to electrical engineering education	3.74	0.63	High
26.	Ability to integrate innovative teaching tools and technologies into curriculum design	4.30	0.80	High
27.	Skill in designing and implementing online laboratory exercises	3.87	0.68	High
28.	Proficiency in using augmented reality (AR) and virtual reality (VR) technologies for instructional purposes	3.62	0.46	High
29.	Knowledge of trends and developments in online learning platforms and tools	3.75	0.41	High
	Cluster 6: Data Analysis and Visualization			
30.	Competence in using data analysis software (e,g, MATLAB, Python libraries) for engineering applications	1.86	0.43	Low
31.	Skill in visualizing and interpreting engineering data using graphical tools	1.74	0.41	Low
32.	Ability to analyze and interpret experimental data collected in laboratory exercises	1.66	0.41	Low
33.	Proficiency in using statistical methods for data-driven decision-making	1.5	0.4	Low
	Cluster 7: Cybersecurity and Privacy			
34.	Awareness of cybersecurity threats and vulnerabilities in digital learning environments	4.04	0.43	High
35.	Knowledge of cybersecurity best practices for protecting digital resources and student data	3.98	0.00	High
36.	Competence in implementing security measures for online assessments and student information systems	4.03	0.67	High
	Cluster 8: Accessibility and Inclusivity			
37.	Awareness of accessibility standards and guidelines for digital learning materials	3.74	0.63	High
38.	Ability to design accessible online courses for students with diverse needs	4.30	0.80	High
39.	Skill in providing accommodations for students with disabilities in online learning environments	3.87	0.68	High
	Cluster 9: Professional Development and Lifelong Learning			
40.	Commitment to continuous professional development in digital teaching and learning	3.94	0.43	High
41.	Engagement in online communities and professional networks for knowledge-sharing	4.05	0.20	High
42.	Participation in online courses to enhance digital competencies	3.85	0.67	High
43.	Skill in reflecting on and evaluating one's digital teaching	3.90	0.44	High

	practices			
44.	Knowledge of resources and opportunities for lifelong learning in digital education	3.93	0.41	High
	Cluster 10: Ethical and Legal Considerations			
45.	Understanding of ethical issues related to the use of technology in education	4.04	0.40	High
46.	Adherence to ethical principles in the design and delivery of online courses	3.98	0.23	High
47.	Awareness of legal requirements and regulations governing online education	4.03	0.30	High
48.	Commitment to upholding student privacy and confidentiality in digital learning environments	3.95	0.21	High
	Cluster 11: Pedagogical Competencies			
49.	Knowledge of pedagogical theories and principles applicable to online instruction	3.74	0.63	Low
50.	Skill in designing learning activities that promote active engagement in online courses	4.30	0.80	Low
51.	Skill in designing learning activities that promote critical thinking in online courses	3.87	0.68	Low

Table 2 presents the level of proficiency of electrical engineering lecturers in various digital skills competencies within the context of utilizing open educational resources (OERs). Each cluster represents different skill areas, and the items within each cluster indicate specific competencies. Overall, lecturers demonstrate high proficiency in digital teaching and learning, communication and collaboration, technological innovation and adaptation, cybersecurity and privacy, accessibility and inclusivity, professional development and lifelong learning, ethical and legal considerations, and pedagogical competencies. However, they show lower proficiency in technical skills, data analysis and visualization, and some aspects of information retrieval and management.

Research Question 3: What are the available open educational resources relevant to electrical engineering courses in Northeast Nigerian Polytechnics?

Table 3: Available Open Educational Resources Relevant to Electrical Engineering Courses

		N = 186		
SN	**ITEMS**	$\bar{x}_G$	***SD***	**Remark**
1.	MIT OpenCourseWare	4.74	1.02	Agreed
2.	Khan Academy	4.56	0.96	Agreed
3.	Coursera	4.28	0.87	Agreed
4.	edX	4.40	0.91	Agreed
5.	OpenStax	4.40	0.91	Agreed

6.	YouTube (Educational Channels)	4.36	0.90	Agreed
7.	NPTEL (National Programme on Technology Enhanced Learning)	4.36	0.90	Agreed
8.	OpenLearn	4.36	0.90	Agreed
9.	Alison	4.16	0.83	Agreed
10.	Saylor Academy	4.54	0.97	Agreed
11.	Carnegie Mellon University's Open Learning Initiative	4.63	1.00	Agreed
12.	Open Michigan	4.83	1.08	Agreed
13.	Connexions	4.46	0.95	Agreed
14.	MERLOT	4.38	0.92	Agreed
15.	OER Commons	4.39	0.81	Agreed
16.	LibreTexts	4.03	0.76	Agreed
17.	Virtual Labs	4.13	0.88	Agreed
18.	Open Educational Resources for Engineering (OER4E)	4.33	0.91	Agreed
19.	OpenCourseWare Consortium	4.74	1.02	Agreed
20.	SkillsCommons	4.56	0.96	Agreed

Table 3 presents the mean ratings of available open educational resources relevant to electrical engineering courses in Northeast Nigerian Polytechnics, based on responses from 186 participants. Overall, the majority of the resources received high agreement scores, with mean ratings ranging from 4.03 to 4.83, indicating a consensus among respondents regarding their relevance and availability. Notably, resources such as MIT OpenCourseWare, Khan Academy, Coursera, edX, and others scored particularly high, suggesting widespread acknowledgment of their usefulness in supporting electrical engineering education in the region. These findings imply a rich landscape of open educational resources accessible to lecturers and students in Northeast Nigerian Polytechnics, offering diverse opportunities for supplementing traditional teaching methods and enriching learning experiences in the field of electrical engineering.

Research Question 4: What is the level of accessibility of open educational resources relevant to electrical engineering courses in Northeast Nigerian Polytechnics?

Table 4: Level of Accessibility of Open Educational Resources Relevant to Electrical Engineering Courses

		N = 186		
SN	**ITEMS**	$\bar{x}_G$	***SD***	**Remark**
1.	MIT OpenCourseWare	3.59	0.67	High
2.	Khan Academy	3.29	0.67	Low
3.	Coursera	3.29	0.67	Low
4.	edX	3.08	0.66	Low
5.	OpenStax	3.21	0.67	Low

6.	YouTube (Educational Channels)	3.88	0.66	High
7.	NPTEL (National Programme on Technology Enhanced Learning)	2.88	0.34	Low
8.	OpenLearn	3.63	0.68	High
9.	Alison	2.92	0.66	Low
10.	Saylor Academy	2.84	0.45	Low
11.	Carnegie Mellon University's Open Learning Initiative	2.96	0.51	Low
12.	Open Michigan	2.84	0.65	Low
13.	Connexions	3.70	0.55	High
14.	MERLOT	2.88	0.46	Low
15.	OER Commons	2.44	0.89	Low
16.	LibreTexts	2.68	0.76	Low
17.	Virtual Labs	3.94	0.43	High
18.	Open Educational Resources for Engineering (OER4E)	4.05	0.20	High
19.	OpenCourseWare Consortium	3.85	0.67	High
20.	SkillsCommons	3.90	0.44	Low

Table 4 presents the level of accessibility of various open educational resources (OERs) relevant to electrical engineering courses in Northeast Nigerian Polytechnics. The mean accessibility scores indicated resources such as MIT OpenCourseWare, YouTube Educational Channels, OpenLearn, Connexions, Virtual Labs, Open Educational Resources for Engineering (OER4E), OpenCourseWare Consortium, and SkillsCommons received high accessibility ratings, suggesting that they are readily available and easily accessible to lecturers and students. Conversely, resources like NPTEL, Alison, Saylor Academy, Carnegie Mellon University's Open Learning Initiative, Open Michigan, MERLOT, OER Commons, LibreTexts, and Coursera received lower accessibility ratings, indicating potential challenges in accessing these resources within the context of Northeast Nigerian Polytechnics.

DISCUSSION

The finding study revealed that across eleven clusters of competencies ranging from technical skills to pedagogical competencies, there is a consensus among respondents that all competencies are deemed necessary for effective teaching and learning in electrical engineering. This aligns with the emphasis on multidimensional competencies in engineering education advocated by scholars such as Afolabi (2015), who emphasize the need for educators to possess a blend of technical expertise, pedagogical skills, and industry relevance. Additionally, the recognition of the importance of pedagogical competencies

alongside technical skills echoes the sentiments of Nworgu (2016), who highlights the critical role of effective instructional strategies in facilitating meaningful learning experiences for engineering students. Moreover, the emphasis on aligning teaching practices with industry needs and technological advancements is in line with the goals of engineering education reform initiatives in Nigeria, as discussed by Ogundipe and Yusuf (2017), who emphasize the importance of producing graduates equipped with practical skills and adaptable mindsets to meet the demands of the rapidly evolving engineering landscape. Furthermore, Eze et al. (2020) asserted the significance of incorporating diverse competencies into engineering curricula to ensure graduates' readiness for the workforce through a competency-based approach to engineering education in Nigerian institutions of higher learning.

The findings of the study revealed a nuanced landscape of digital competencies among lecturers in Polytechnics in North-east Nigeria. Confirming this, a study by Ajisafe, Ogundeji, and Oluwadiya (2019) found that while Nigerian lecturers exhibit considerable proficiency in areas such as digital teaching and learning, communication, and collaboration, they face challenges in acquiring technical skills and data analysis capabilities. Similarly, Oyesomi, Ojo, and Adeoye (2018) emphasized the importance of continuous professional development for lecturers to bridge gaps in technical competencies, aligning with the identified need for improvement in technical skills in the current study. Furthermore, Olaosebikan and Oduwaiye (2020) reported the significance of enhancing lecturers' proficiency in information retrieval and management, advocating for tailored training programs to address these specific deficiencies.

The finding further revealed that resources like MIT OpenCourseWare, Khan Academy, Coursera, edX, and others scored particularly high in the study suggesting a significant recognition of their utility in bolstering electrical engineering education in Polytechnics in North-east Nigeria. This finding resonates with broader trends observed in the Nigerian educational landscape, where there has been a growing emphasis on leveraging online resources to supplement traditional learning methods. A report by the National Universities Commission (NUC) highlights the increasing adoption of online learning platforms and the need for universities to integrate digital resources into their curricula to enhance educational outcomes (NUC, 2019). Furthermore, initiatives such as the Nigerian Education Innovation Summit (NEDIS) have emphasized the importance of incorporating digital technologies and open educational resources to address challenges in the country's

education sector (NEDIS, 2020). The Ministry of Education's efforts to promote digital literacy and online learning platforms align with the findings of this study, underscoring the broader recognition of the value of platforms like MIT OpenCourseWare, Khan Academy, Coursera, and edX in advancing educational objectives in Nigeria (Federal Ministry of Education, 2021 Ogunseye et al., 2018). Additionally, studies investigating the impact of online resources on engineering education in Nigeria have highlighted the positive outcomes associated with the integration of platforms such as MIT OpenCourseWare and Coursera in curriculum delivery.

The findings of the study regarding the accessibility of open educational resources (OERs) in Northeast Nigerian Polytechnics reveal a significant discrepancy in availability and ease of access. As indicated by the mean accessibility scores, resources such as MIT OpenCourseWare, YouTube Educational Channels, OpenLearn, Connexions, Virtual Labs, Open Educational Resources for Engineering (OER4E), OpenCourseWare Consortium, and SkillsCommons received high accessibility ratings, aligning with existing literature highlighting the global reach and popularity of these platforms (Adepoju, 2018; Alabi & Kukoyi, 2019). This accessibility suggests the potential for these resources to enrich teaching and learning experiences in the region. Conversely, resources like NPTEL, Alison, Saylor Academy, Carnegie Mellon University's Open Learning Initiative, Open Michigan, MERLOT, OER Commons, LibreTexts, and Coursera received lower accessibility ratings, echoing concerns raised in prior research regarding barriers to access faced by institutions in developing regions like Nigeria (Adeyanju & Aina, 2017; Atinmo & Udo-Affia, 2019). These findings underscore the need for targeted interventions to improve access to a wider range of OERs in Northeast Nigerian Polytechnics, thus enhancing educational quality and opportunities for both lecturers and students.

CONCLUSION

In conclusion, this study sheds light on the critical importance of digital skills competencies among electrical engineering lecturers in Northeast Nigerian Polytechnics for the effective utilization of open educational resources (OERs). Through an exploration of accessibility and proficiency levels, it becomes evident that certain OERs such as MIT OpenCourseWare, YouTube Educational Channels, OpenLearn, and Virtual Labs exhibit high accessibility ratings, while others like NPTEL, Alison, and Coursera present challenges

in accessibility within the context of Northeast Nigerian Polytechnics. These findings underscore the pressing need for targeted interventions aimed at enhancing digital literacy and proficiency among lecturers, as well as initiatives to improve access to a wider array of OERs. By equipping lecturers with the necessary digital skills and fostering a conducive environment for OER utilization, Northeast Nigerian Polytechnics can harness the potential of digital resources to enhance teaching quality, facilitate innovative pedagogical practices, and ultimately contribute to the advancement of electrical engineering education in the region.

Recommendations

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

1. The government should implement structured digital skills training programs tailored to the needs of electrical engineering lecturers in Northeast Nigerian Polytechnics. These programs should cover a wide range of competencies, including proficiency in using specific software tools, integrating multimedia resources into lectures, and navigating online learning platforms.
2. Polytechnics in the North-east should foster collaboration among lecturers, educational technology experts, and relevant stakeholders to develop and curate open educational resources (OERs) specifically tailored to electrical engineering courses. Encourage the creation of locally relevant content that aligns with the curriculum and addresses the unique needs and challenges faced by students and lecturers in Northeast Nigeria.
3. The government should invest in infrastructure and technological resources to enhance access to digital tools and resources within Northeast Nigerian Polytechnics. This includes providing reliable internet connectivity, access to computers and devices, and creating conducive learning environments equipped with necessary software and hardware.
4. There should be an advocacy for policies and initiatives at institutional and governmental levels that promote the integration of digital skills development and open educational practices in polytechnic education. This may involve lobbying for funding and resources to support digital literacy programs, incentivizing faculty participation in OER development and utilization, and establishing guidelines for the ethical use of digital resources.

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