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This study investigated the availability, accessibility, and utilization of emerging technologies for scholarly communication among Library and Information Science (LIS) professionals in Federal Universities in North-East Nigeria. The main objective was to identify the types of emerging technologies available for scholarly communication within this context. A quantitative survey design was employed, targeting LIS professionals across three selected federal universities using a census sampling technique. A total of 263 valid responses were retrieved through structured questionnaires. Findings show a significant relationship between availability, accessibility, and utilization of emerging technologies among the Library and information science professionals of federal universities in north-east Nigeria. Findings revealed that social media, digital archives, open educational resources (OER), and learning management systems (LMS) were the most commonly available technologies. In contrast, advanced innovations such as blockchain, virtual reality, and 3D printing were scarcely available. Awareness and accessibility varied, with moderate levels observed for generative artificial intelligence (GAI) and cloud computing; the adequacy of most emerging technologies was found to be below optimal. Major barriers to utilization included limited funding, inadequate digital infrastructure, lack of training, and weak institutional support. The study recommends increased investment by university administrations and government agencies in digital infrastructure and funding. It also advocates for comprehensive awareness campaigns through workshops, training, and curriculum integration, particularly targeting lesser-known emerging technologies, strategic investment in digital infrastructure and professional training to enhance scholarly communication practices among LIS professionals of Federal Universities of North-East Nigeria.

Keywords: *Accessibility, Awareness, Digital Infrastructure, Emerging Technologies, Federal Universities, Library and Information Science (LIS), North-East Nigeria, Professional Development, Scholarly Communication, Technology Utilization*

Introduction

Emerging Technologies (ETs) are innovations that are currently developing or expected to evolve over the coming years, significantly altering social, economic, and scholarly environments (Wedel, Bigné, & Zhang, 2020). Examples include Artificial Intelligence (AI), Machine Learning, Blockchain Technology, Internet of Things (IoT), Quantum Computing, Augmented and Virtual Reality (AR/VR), 3D Printing, Cloud Computing, and Big Data Analytics. In the context of academia, Open Access and Open Science platforms have emerged as transformative forces in scholarly communication (Harnad, 2011; Madalli, 2015).

ETs have the potential to transform scholarly communication by improving visibility, peer review, collaboration, and access to research outputs (Crawford, Allen, & Lodge, 2024; Mannuru et al., 2023). Social media platforms like Twitter and ResearchGate, for instance, enable faster dissemination and visibility of scholarly work (Hooley et al., 2024). Open repositories and digital libraries offer improved access to grey literature, preprints, and datasets, while AI is increasingly being adopted to support peer-review workflows and plagiarism checks (Wheeler et al., 2022).

However, adoption of ETs among Library and Information Science (LIS) professionals in Nigeria; particularly in the North-East, is still emerging. Studies show low usage of institutional repositories beyond deposit functions (Turner & Sauer, 2022), and limited adoption of social media and reference managers like Mendeley for academic engagement (Shrivastava & Mahajan, 2016). Moreover, there is limited understanding of how scholarly content transitions from academia to social media spaces and the factors that influence diffusion patterns (Zhang et al., 2014).

Key barriers hindering the uptake of these technologies include infrastructural challenges, insufficient professional development, and limited institutional support (Adeyeye & Oladokun, 2023; Jimoh, Abdullahi, & Ibrahim, 2019). Despite the strategic role LIS professionals play in research support and dissemination, their awareness and engagement with ETs is under-documented in Nigeria. This digital divide may affect global research participation and innovation in knowledge production (Nicholas et al., 2017).

This study therefore investigates the availability, accessibility, and utilization of emerging technologies among LIS professionals in federal universities in North-East Nigeria. Specifically, it assesses levels of awareness, access, adequacy, and use of these technologies to inform future policy development and capacity-building efforts.

Research Questions

The following research questions were investigated:

1. What are the types of emerging technologies available for scholarly communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?
2. What is the extent of access to emerging technologies for scholarly communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?
3. What is the extent of utilization of these emerging technologies for scholarly communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?

Methodology

This study adopted a quantitative approach using a descriptive survey design to collect data on the availability and utilization of emerging technologies for scholarly communication. The population consisted of 263 Library and Information Science (LIS) professionals who are either academic librarian or lecturers from three federal universities in north-east Nigeria: Abubakar Tafawa Balewa University (Bauchi), University of Maiduguri (Borno), and Modibbo Adama University (Yola). A census sampling technique was adopted to ensure full coverage of the population. A structured questionnaire was administered to the respondents. The data collected were analyzed using descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics (chi-square and multiple regression) at a 0.05 significance level, using SPSS.

Results

What are the Types of Emerging Technologies Available for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?

The researcher sought to determine the types of Emerging Technologies Available for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria. Responses from the respondents were collected, analysed and presented in Table 1.

Table 1 Emerging Technologies Available for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria.
N= 263

Types of Emerging Technologies	Frequency	Percentage (%)
Learning Management Systems (LMS)	144	55
Open Educational Resources (OER)	200	76
Digital Archives and Repositories	202	77
Virtual Reality	73	28
Social Media	212	81
Citation Management Software	133	51
Research Data Management Tools	84	32
Podcasting and other Audio Technologies	25	10
Generative Artificial Intelligence	184	70
3D printing and Scanning	55	21
Cloud Computing and Storage	109	41
Internet of Things (IoT)	132	50
Blockchain Technology	67	25

Source: Field Survey, 2024

Table 1 indicates that the most commonly recognised types of emerging technologies to the respondents are Social Media 212 (81%), Digital Archives and Repositories 202 (77%) and Open Educational Resources (OER) 200 (76%). Furthermore, Generative Artificial Intelligence (GAI) 184 (70%) and Internet of Things 132 (50%) were found available by the respondents. Other available emerging technologies used by library and information science researchers are Cloud Computing and Storage 109 (41%), Research Data Management Tools 84 (32%), Virtual Reality 73 (28%), Blockchain Technology 67 (25%), 3D Printing and Scanning 55 (21%), and Podcasting and other Audio Technologies 25 (10%) are lesser-known emerging technologies. This suggests that these emerging technologies are still in the early stages of adoption and are less integrated into the Nigerian scholarly communication system.

The prevalence of Social Media and Digital Archives and Repositories indicates the respondents' views on the perceived usefulness (Performance Expectancy) and the supportive environment (Facilitating Conditions) but also from the intrinsic enjoyment (Hedonic Motivation) users derive from these emerging technologies. It was noted that conversely, the limited availability of other emerging technologies like Blockchain and Virtual Reality could be attributed to factors such as high perceived costs (Price Value) or a lack of habitual usage patterns (Habit) among the Library and Information Science Professionals.

What is the Extent of Access to Emerging Technologies for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?

The researcher sought to determine the Extent of Access to Emerging Technologies for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria. Responses from the respondents were collected, analysed and presented in Table 2.

Table 2 Extent of access to emerging technologies for scholarly communication among Library and Information Science

Professionals of Federal Universities in North-East Nigeria.

N=263

Emerging Technologies	VHE	HE	ME	LE	NA	M	SD	Decision
Learning Management Systems (LMS)	39 (15%)	184 (70%)	16 (6%)	13 (5%)	10 (4%)	4.15	0.67	High
Open Educational Resources (OER)	163 (62%)	50 (19%)	32 (12%)	9 (3%)	5 (2%)	4.45	0.64	High
Virtual Reality	0 (0%)	26 (10%)	29 (11%)	79 (30%)	129 (49%)	2.05	1.03	Low
Digital Archives and Repositories	210 (80%)	39 (15%)	14 (5%)	0 (0%)	0 (0%)	4.75	0.44	High
Social Media	53 (20%)	184 (70%)	13 (5%)	13 (5%)	0 (0%)	4.15	0.67	High
Citation Management Software	9 (3%)	105 (40%)	39 (15%)	97 (37%)	13 (5%)	3.05	0.98	Moderate
Research Data Management Tools	0 (0%)	132 (50%)	79 (30%)	26 (10%)	26 (10%)	3.30	0.94	Moderate
Podcasting and other Audio Technologies	0 (0%)	210 (80%)	39 (15%)	13 (5%)	0 (0%)	4.15	0.67	High
Generative Artificial Intelligence (GAI)	63 (24%)	132 (50%)	26 (10%)	26 (10%)	16 (6%)	3.65	0.84	High

3D Printing and Scanning	0 (0%)	39 (15%)	132 (50%)	79 (30%)	13 (5%)	2.95	1.04	Low
Cloud Computing and Storage	39 (15%)	184 (70%)	10 (4%)	13 (5%)	16 (6%)	4.15	0.67	High
Internet of Things (IoT)	39 (15%)	26 (10%)	0 (0%)	132 (50%)	66 (25%)	2.45	1.12	Low
Blockchain Technology	0 (0%)	39 (15%)	13 (5%)	79 (30%)	132 (50%)	2.05	1.03	Low

Source: Field Survey, 2024

Key: VHE: Very High Extent, HE: High Extent, ME: Moderate Extent, LE: Low Extent, NA: Not Accessible,

M: Mean, SD: Standard Deviation

Decision Rule: ($M < 3.0$ = Low; $M \geq 3.0$ = Moderate; $M \geq 3.5$ = High)

Table 2 shows the extent of access to emerging technologies for scholarly communication among Library and Information Science Professionals in Federal Universities in North-East Nigeria varies significantly. The analysis reveals varying levels of accessibility thus: Learning Management Systems (LMS) access is high, with 39 (15%) respondents reporting very high extent, 184 (70%) high extent, 16 (6%) moderate extent, 13 (5%) low extent, and 10 (4%) not accessible, resulting in a mean of $M = 4.15$ and a standard deviation of $SD = 0.67$; Open Educational Resources (OER) access is high, with 163 (62%) respondents reporting very high extent, 50 (19%) high extent, 32 (12%) moderate extent, 9 (3%) low extent, and 5 (2%) not accessible, resulting in a mean of $M = 4.45$ and a standard deviation of $SD = 0.64$; Virtual Reality access is low, with no 0 (0%) respondents reporting a very high extent, 26 (10%) high extent, 29 (11%) moderate extent, 79 (30%) low extent, and 129 (49%) not accessible, resulting in a mean of $M = 2.05$ and a standard deviation of $SD = 1.03$; Digital Archives and Repositories access is high, with 210 (80%) respondents reporting very high extent, 39 (15%) high extent, 14 (5%) moderate extent, and none reporting low extent or not accessible, resulting in a mean of $M = 4.75$ and a standard deviation of $SD = 0.44$; Social Media access is high, with 53 (20%) respondents reporting very high extent, 184 (70%) high extent, 13 (5%) moderate extent, 13 (5%) low extent, and none reporting not accessible, resulting in a mean of $M = 4.15$ and a standard deviation of $SD = 0.67$; Citation Management Software access is moderate, with 9 (3%) respondents reporting very high extent, 105 (40%) high extent, 39 (15%) moderate extent, 97 (37%) low extent, and 13 (5%) not accessible, resulting in a mean of $M = 3.05$ and a standard deviation of $SD = 0.98$; Research Data Management Tools access is moderate, with no 0 (0%) respondents reporting very high extent, 132 (50%) high extent, 79 (30%) moderate extent, 26 (10%) low extent, and 26 (10%) not accessible, resulting in a mean of $M = 3.30$ and a standard deviation of $SD = 0.94$; Podcasting and Other Audio Technologies access is high, with no 0 (0%) respondents reporting very high extent, 210 (80%) high extent, 39 (15%) moderate extent, 13 (5%) low extent, and none reporting not accessible, resulting in a mean of $M = 4.15$ and a standard deviation of $SD = 0.67$; Generative Artificial Intelligence (GAI) access is high, with 63 respondents (24%) reporting very high extent, 132 (50%) high extent, 26 (10%) moderate extent, 26 (10%) low extent, and 16 (6%) not accessible, resulting in a mean of $M = 3.65$ and a standard deviation of $SD = 0.84$; 3D Printing and Scanning access is low, with no 0 (0%) respondents reporting very high extent, 39 (15%) high extent, 132 (50%) moderate extent, 79 (30%) low extent, and 13 (5%) not accessible, resulting in a mean of $M = 2.95$ and a standard deviation of $SD = 1.04$; Cloud Computing and Storage access is high, with 39 (15%) respondents reporting very high

extent, 184 (70%) high extent, 10 (4%) moderate extent, 13 (5%) low extent, and 16 (6%) not accessible, resulting in a mean of $M = 4.15$ and a standard deviation of $SD = 0.67$; Internet of Things (IoT) access is low, with 39 (15%) respondents reporting very high extent, 26 (10%) high extent, none reporting moderate extent, 132 (50%) low extent, and 66 (25%) not accessible, resulting in a mean of $M = 2.45$ and a standard deviation of $SD = 1.12$; Blockchain Technology access is low, with no 0 (0%) respondents reporting very high extent, 39 (15%) high extent, 13 (5%) moderate extent, 79 (30%) low extent, and 132 (50%) not accessible, resulting in a mean of $M = 2.05$ and a standard deviation of $SD = 1.03$.

These findings indicate that while certain technologies like Digital Archives and Repositories, Open Educational Resources, and Social Media are highly accessible to professionals, others such as Virtual Reality, 3D Printing, the Internet of Things, and Blockchain Technology have lower levels of accessibility.

What is the Extent of Utilisation of Emerging Technologies for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria?

The researcher sought to determine the extent of the Utilisation of Emerging Technologies for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North-East Nigeria. Responses from the respondents were collected, analysed and presented in Table 3.

Table 3 Extent of Utilisation of Emerging Technologies for Scholarly Communication among Library and Information Science Professionals of Federal Universities in North -East Nigeria
N=263

Emerging Technologies	VHE	HE	ME	LE	NU	M	SD	Decision
Learning Management Systems (LMS)	40 (15%)	39 (15%)	124 (47%)	52 (20%)	8 (3%)	3.27	0.96	Moderate
Open Educational Resources (OER)	52 (20%)	132 (37%)	99 (27%)	40 (8%)	39 (8%)	3.52	1.04	High
Virtual Reality	0 (0%)	10 (3%)	18 (5%)	132 (50%)	79 (30%)	1.99	1.30	Low
Digital Archives and Repositories	7 (0%)	77 (15%)	132 (50%)	40 (20%)	7 (15%)	2.85	0.96	Low
Social Media	211 (80%)	31(4%)	11 (12%)	10 (4%)	0 (0%)	4.36	0.53	High
Citation Management Software	10 (3%)	42 (16%)	131 (50%)	40 (15%)	40 (15%)	2.87	1.00	Low
Research Data Management Tools	22 (8%)	39 (15%)	52 (20%)	110 (42%)	40 (15%)	2.37	1.14	Low
Podcasting and other Audio Technologies	32 (12%)	50 (19%)	30 (11%)	51 (20%)	100 (38%)	2.14	1.23	Low
Generative Artificial Intelligence (GAIs)	39 (15%)	132 (50%)	111 (42%)	52 (20%)	28 (11%)	3.67	0.94	High
3D Printing and Scanning	0 (0%)	39 (15%)	79 (30%)	132 (50%)	13 (5%)	2.54	0.92	Low
Cloud Computing and Storage	12 (5%)	50 (20%)	132 (50%)	29 (11%)	40 (15%)	2.95	0.92	Low
Internet of Things (IoT)	0 (0%)	39 (15%)	40 (15%)	132 (50%)	52 (20%)	2.01	1.18	Low
Blockchain Technology	2 (1%)	37 (14%)	13 (5%)	122 (46%)	89 (34%)	2.02	1.18	Low

Source:Field Survey, 2024

Key: VHE: Very High Extent, HE: High Extent, ME: Moderate Extent, LE: Low Extent, NU:

Not Utilised at All, M: Mean, SD: Standard Deviation

Decision Rule: ($M < 3.0$ = Low; $M \geq 3.0$ = Moderate; $M \geq 3.5$ = High)

Table 3 presents the extent of utilization of various emerging technologies by Library and Information Science (LIS) researchers in North-East Nigeria. The results highlight significant variations in the adoption of these emerging technologies thus the extent of utilization of emerging technologies for scholarly communication among Library and Information Science professionals in Federal Universities in North-East Nigeria varies across different emerging technologies for scholarly communications thus: Learning Management Systems (LMS) are utilized to a moderate extent, with 40 (15%) respondents indicating very high extent, 39 (15%) high extent, 124 (47%) moderate extent, 52 (20%) low extent, and 8 (3%) not utilized at all, resulting in a mean of $M = 3.27$ and a standard deviation of $SD = 0.96$; Open Educational Resources (OER) have a high extent of utilization, with 52 (20%) respondents reporting very high extent, 132 (37%) high extent, 99 (27%) moderate extent, 40 (8%) low extent, and 39 (8%) not utilized at all, leading to a mean of $M = 3.52$ and $SD = 1.04$;

Virtual Reality is utilized to a low extent, as no 0 (0%) respondents reported very high extent, 10 (3%) high extent, 18 (5%) moderate extent, 132 (50%) low extent, and 79 (30%) not utilized at all, with a mean of $M = 1.99$ and $SD = 1.30$; Digital Archives and Repositories also show low utilization, with 7 (3%) respondents indicating very high extent, 77 (15%) high extent, 132 (50%) moderate extent, 40 (20%) low extent, and 7 (15%) not utilized at all, resulting in a mean of $M = 2.85$ and $SD = 0.96$; Social Media platforms are highly utilized, with 211 (80%) respondents reporting very high extent, 31 (4%) high extent, 11 (12%) moderate extent, 10 (4%) low extent, and none 0 (0%) not utilized at all, leading to a mean of $M = 4.36$ and $SD = 0.53$; Citation Management Software is utilized to a low extent, with 10 (3%) respondents indicating very high extent, 42 (16%) high extent, 131 (50%) moderate extent, 40 (15%) low extent, and 40 (15%) not utilized at all, resulting in a mean of $M = 2.87$ and $SD = 1.00$; Research Data Management Tools are also utilized to a low extent, with 22 (8%) respondents reporting very high extent, 39 (15%) high extent, 52 (20%) moderate extent, 110 (42%) low extent, and 40 (15%) not utilized at all, leading to a mean of $M = 2.37$ and $SD = 1.14$; Podcasting and other Audio Technologies show low utilization, with 32 (12%) respondents indicating very high extent, 50 (19%) high extent, 30 (11%) moderate extent, 51 (20%) low extent, and 100 (38%) not utilized at all, resulting in a mean of $M = 2.14$ and $SD = 1.23$.

Generative Artificial Intelligence (GAIs) have a high extent of utilization, with 39 (15%) respondents reporting very high extent, 132 (50%) high extent, 111 (42%) moderate extent, 52 (20%) low extent, and 28 (11%) not utilized at all, leading to a mean of $M = 3.67$ and $SD = 0.94$; 3D Printing and Scanning technologies are utilized to a low extent, with no respondents (0%) indicating very high extent, 39 (15%) high extent, 79 (30%) moderate extent, 132 (50%) low extent, and 13 (5%) not utilized at all, resulting in a mean of $M = 2.54$ and $SD = 0.92$; Cloud Computing and Storage is also utilized to a low extent, with 12 (5%) respondents reporting very high extent, 50 (20%) high extent, 132 (50%) moderate extent, 29 (11%) low extent, and 40 (15%) not utilized at all, leading to a mean of $M = 2.95$ and $SD = 0.92$; The Internet of Things (IoT) shows low utilization, with no 0 (0%) respondents indicating very high extent, 39 (15%) high extent, 40 (15%) moderate extent, 132 (50%) low extent, and 52 (20%) not utilized at all, resulting in a mean of $M = 2.01$ and $SD = 1.18$; Blockchain Technology is also utilized to a low extent, with 2 respondents (1%) reporting very high extent, 37 (14%) high extent, 13 (5%) moderate extent, 122 (46%) low extent, and 89 (34%) not utilized at all, leading to a mean of $M = 2.02$ and $SD = 1.18$.

Emerging Technologies such as Open Educational Resources (OER), Digital Archives and Repositories, Social Media, and Generative Artificial Intelligence (GAIs) are highly

utilized, indicating a strong integration into scholarly communication practices. On the other hand, technologies like Virtual Reality, 3D Printing and Scanning, the Internet of Things (IoT), and Blockchain Technology are utilized to a lesser extent, suggesting potential areas for increased adoption or training. Specifically, Social Media platforms exhibit the highest utilization, with 211 (80%) of respondents reporting very high extent usage. Open Educational Resources (OER) and Generative Artificial Intelligence (GAIs) also show high utilization, with 52 (20%) and 39 (15%) of respondents, respectively, indicating very high extent usage. In contrast, Virtual Reality, 3D Printing and Scanning, IoT, and Blockchain Technology have lower utilization rates, with Virtual Reality and Blockchain Technology showing the least usage.

These findings suggest that while certain technologies are well-integrated into scholarly communication practices, others may require additional infrastructure, training, or awareness to enhance their utilization among professionals in the region.

Discussion

Discussion The findings indicate that widely available technologies such as social media, digital repositories, and generative AI are highly adopted by LIS professionals in North-East Nigeria. These tools are accessible and easy to use, which facilitates their integration into scholarly workflows. In contrast, advanced tools such as blockchain, virtual reality, and the Internet of Things remain underutilized due to high costs, limited infrastructure, and insufficient training.

These trends align with existing research, which highlights the growing role of generative AI and open access platforms in scholarly communication (Ugwu et al., 2021; Madalli, 2015; Mannuru et al., 2023), while also reflecting the early-stage adoption challenges of more complex technologies (Jimoh, Abdullahi, & Ibrahim, 2019; Rashidibajgan & Hupperich, 2024).

The disparity in access and utilization underscores a digital divide that can hinder participation in global research. Prior studies (Harnad, 2011; Nicholas et al., 2017) support this, emphasizing the role of institutional funding, policy, and digital inclusion. Improving technological access and usage requires investments in infrastructure and human capital, as well as strategic partnerships.

The findings also align with recent studies (Ajayi et al., 2024; Adeyeye & Oladokun, 2023) that show low adoption of complex tools despite growing awareness. To bridge this gap, institutions must promote awareness campaigns, capacity-building workshops, and improved funding schemes to encourage the broader adoption of emerging technologies.

Conclusion

This study determined the availability, accessibility, and utilization of emerging technologies for scholarly communication among Library and Information Science (LIS) professionals in selected federal universities in North-East Nigeria. Findings of this study revealed that while tools such as social media, digital archives, OER, and LMS are widely available and moderately utilized, advanced technologies like blockchain, virtual reality, and 3D printing remain largely inaccessible and underutilized.

Recommendations

1. Federal universities should increase funding and collaborate with technology providers to improve access to underutilized emerging technologies.

2. Institutions should implement targeted training and awareness programs to build digital literacy among LIS professionals.
3. Policies supporting infrastructure development and sustainable technology adoption should be prioritized to enhance scholarly communication.

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