



**INFORMATION ARCHITECTS OF TOMORROW:
ADDRESSING THE DIGITAL TURN**

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**College Librarians' Association,
Kerala (KCLA)**

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Information Architects of Tomorrow: Addressing the Digital Turn 2026

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PREFACE

The theme *Information Architects of Tomorrow: Addressing the Digital Turn* highlights the vital role of library and information professionals in today's fast-changing digital world. Libraries are no longer confined to storing and lending printed materials; they now support digital learning, online research, data management, artificial intelligence tools, and open access services. As technology continues to advance, librarians are expected to adapt to new digital environments and to guide users in accessing, evaluating, and using information effectively.

This edited volume has been published in connection with the National Seminar organised by the College Librarians' Association Kerala (KCLA), in association with the Kerala State Higher Education Council (KSHEC) and St. Paul's College, Kalamassery, held on 22–23 May 2026 in Kochi, Kerala. The seminar provided a vibrant platform for librarians, researchers, academicians, and students to share ideas and research on digital libraries, artificial intelligence, information literacy, cybersecurity, scholarly communication, and other emerging areas in Library and Information Science. The chapters collected here represent the voices of scholars and professionals from across India. They explore themes such as sustainable digital libraries, inclusive

services, digital marketing of resources, information ethics and privacy, institutional repositories, AI tools in research and writing, bibliometric studies, and the digital transformation of academic libraries. We are grateful to all the authors for their contributions, and to the organising committee, reviewers, and editorial board members for their support. We also thank the College Librarians' Association Kerala, the Kerala State Higher Education Council, and St. Paul's College for making this publication possible.

We hope this volume serves as a useful resource for librarians, researchers, teachers, students, and information professionals, and that it encourages further thought and enquiry in the field of Library and Information Science.

Dr. Gilu G. Ettaniyil

Dr. Binu P.C.

Muhammed Siyad P.S.

FOREWORD

Libraries are experiencing a profound transformation, moving beyond their traditional role as repositories of books to become dynamic centres of digital learning, research, and information management. *Information Architects of Tomorrow: Addressing the Digital Turn* captures this transition with clarity, offering scholarly perspectives on data privacy, cybersecurity, artificial intelligence, inclusive services, and sustainable practices. The volume provides timely insights into the challenges and opportunities of the digital era.

The chapters presented here reflect the dedication of library and information professionals to embrace new technologies while safeguarding ethical values and user trust. By addressing themes such as information literacy, institutional repositories, and service innovation, the book demonstrates how libraries can remain resilient and relevant in a rapidly changing environment. It also emphasises the importance of interdisciplinary approaches that integrate technology, ethics, and policy in shaping the future of information services.

I extend my warm congratulations to all who contributed to the successful completion of this publication. Their collective effort has produced a valuable resource for librarians, researchers, and students, one that will inspire further enquiry and innovation. May this work guide information professionals to act as true knowledge architects in the digital age.

Prof. (Dr.) Pramada Ramachandran
Principal, St. Paul's College, Kalamassery

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DATA PRIVACY AND CYBERSECURITY IN LIBRARIES: A BIBLIOMETRIC REVIEW

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Abstract

The rapid growth of digital technologies in libraries has brought essential apprehensions in the areas of data privacy and cybersecurity. As a result of transitions of libraries into hubs of digital information, they have to sensitively manage the large amount of user data while protecting the devices against cyber threats. In this background, the present study conducts inclusive bibliometric research on data privacy and cybersecurity in libraries. The study aims to examine the trends in publications, collaboration and citation patterns, author productivity,

highly cited documents, and keyword occurrences. For this study, a bibliometric analysis was conducted with 117 journal articles extracted from the OpenAlex databases, which covers the period of 2010 to 2026. Biblioshiny and Excel tools were selected to identify the growth in publications, citation analysis, collaboration network, authorship productivity, most relevant countries, institutions, and keyword occurrences. The outcome of the study reveals that in recent years, there has been a significant growth in research output, which emphasizes the increase in scholarly interest in the field. This study not only contributes to understanding the present research landscape but also gives a foundation for future discoveries, policy development, and inspiring deeper teamwork and creative solutions to address the complex challenges in this field.

Keywords: Cybersecurity, Libraries, Data Privacy, OpenAlex, Digital Libraries, Research Trends, and Information Security.

1. Introduction

The traditional role of libraries has shifted from the physical repositories of information to an active and online digital knowledge environment due to the progress in the adoption of new features in digital technologies. The present libraries lie on digital repositories, online service platforms, cloud computing, and an integrated library system to give unified and effective access to information. This progress has led to user engagement and accessibility, which, at the same time, introduced compound challenges related to data privacy and cybersecurity. Including usage patterns, personal information, and search histories, the libraries deal with a large quantity of sensitive user data, and enabling the libraries as potential targets for cyber threats (Adakawa et al., 2025).

One of the main principles in library and information science is data privacy, which is very closely connected to ethical responsibility and intellectual freedom to safeguard the user's confidentiality. Conventionally, the libraries made sure that the patrons could access resources without fear of misuse or surveillance of their personal data. The data privacy refers to digital resources usage, search queries, identifying and locating

the information and resources, and including circulation histories (Alemneh et al., 2020). But the shift to digital settings has complicated these practices. In modern libraries, different types of data are collected, such as online usage patterns, membership details, and circulation records (Jones & Salo, 2022). If these are not properly managed it can expose users to risks such as data breaches, unauthorized access, and misuse by third parties (Abdelrahman, 2024). To address these risks, the libraries must follow ethical and legal agendas, including professional codes and national data protection laws, while introducing best practices like secure authentication, data minimization, and continuous training to staff, and encryption (Ajie, 2019). The artificial intelligence tools and technology and big data analytics are useful for refining services and need careful handling to overcome compromising user privacy (Ngwum et al., 2020).

Due to the escalating sophistication and frequency of cyberattacks in libraries, cybersecurity has become a critical issue. While managing important information assets, libraries are mainly valuable because they often operate with limited technical infrastructure (Akor et al., 2024.). Some of the cyber threats that libraries go through are compromising sensitive data, phishing, unauthorized access, malware, and ransomware attacks. The latest studies indicate that cyber-attacks on information institutions have grown mainly in recent years, emphasizing the urgent requirement for robust cybersecurity frameworks (Musa et al., 2025).

1.2. Literature Review

Adakawa et al. (2025) stated in their study that in library data privacy remains an essential value, which is rooted in safeguarding user confidentiality and intellectual freedom. However, the digital surroundings have addressed the complexities that challenge the privacy frameworks traditionally. Advancements in the digital age have improved in accessing the information but also increased the scope of cybersecurity risks and require stronger technological safeguards (Akor et al., 2024). (Igbinovia et al. 2023) mentioned in their studies that libraries are

often vulnerable to cyber threats like phishing and ransomware, with a lack of infrastructure constantly aggravating these risks. Constantly taking data backups helps to secure against data loss and other processes in preserving the data (Abie et al., 2004). Educating the patterns is essential in modifying the privacy risks, as many patterns remain not aware of data security threats in digital environments (Gupta et al., 2020). While introducing the security measures, the required workshops, and hands-on training in cybersecurity skills, the library authorities have essential roles (Oladokun et al., 2025). The main challenges, like ethical considerations in data management, balance the service efficiency with ethical responsibility in handling used data. (Alhassan et al., 2023) mentioned in their study that the impact of COVID – 19 enhanced the digital adoption, growing exposure to cybersecurity threats. The studies on bibliometric shows that developing scholarly interest which highlight the multidisciplinary nature of cybersecurity research in libraries (VanNatta, 2024).

1.3. Significance of the study

The study reports timely and strongly relevant issues in the context of digital transformation. As libraries constantly increase the adoption of digital platforms and manage large volumes of user data, the anxieties connected to data privacy and cybersecurity have become very critical (Abie et al., 2004). The outcomes of the present study can enable the library professionals, administrators, information leaders, and policy makers in implementing effective cybersecurity measures, strengthening data governance frameworks, and developing informed strategies to protect user information. The study examines the key research gaps and increasing trends, thereby giving a strong foundation for future scholarly investigations. The study emphasizes the requirement for interdisciplinary approaches that integrate policy and ethical perspectives to report the multifaceted challenges related to data privacy and cybersecurity in libraries (Adakawa et al., 2025; & Alhassan et al., 2023). By providing a clear-cut direction for future research, this study contributes to the progress of knowledge

and supports the growth of secure and privacy-conscious library surroundings in the digital age.

1.4. Research Questions

What are the publication trends and citation patterns in the field of data privacy and cybersecurity in libraries?

Who are the key contributors and what are the collaboration patterns, in terms of most relevant authors, countries, and research productivity?

What are the major research themes and impact of the field, based on keyword occurrences, highly cited documents, and author productivity following Lotka's Law?

1.5. Methodology

The study uses a quantitative bibliometric research design to methodically analyse the scholarly literature on Data Privacy and Cybersecurity in Libraries. According to Donthu et al. (2021) the bibliometric analysis is recognized as a globally used method for examining emerging trends, evaluating scientific methods, mapping intellectual structure of the research, measuring scholarly impact, and research performance with a specific subject. The study aims to examine the trends in publications, collaboration and citation patterns, author productivity, highly cited documents and keyword occurrences related to data privacy and cybersecurity in libraries. The data for the study were extracted from the OpenAlex database. It is a comprehensive and open scholarly platform that gives access to metadata on institutions, authors, publications, research concepts, and keywords. The search was done on 03.04.2026 and covered publications between 2010 to 2026 up to 03.04.2026, using the search string "Data Privacy" and "Cyber Security" and libra*. The truncation operator (libra) was used to retrieve records including terms like library, librarians, libraries, and librarianship. To keep the standard of the relevance and quality of the datasets, the inclusion and exclusion criteria were used. The inclusion criteria were journal articles published between 2010 to 2026 (03.04.2026), open-access publications,

articles published in the English language, and studies on the domain of data privacy and cybersecurity issues within library and information science areas. The exclusion criteria included conference papers, dissertations, book chapters, reviews, editorials and other non-journal publications, studies not directly related to library and information science, non-English publications, and duplicate records. After applying these criteria, the final dataset of 117 articles was selected for analysis. The bibliometric process included 4 stages. The first relevant records were retrieved from the OpenAlex database using the clear and aureate search string, and the second, the records were screened and cleaned by removing duplicates and excluding irrelevant publications based on the inclusion and exclusion criteria. The third dataset was exported and used with Biblioshiny and MS Excel. Biblioshiny was used to perform descriptive and performance analyses, including country-wise production, network collaboration, annual scientific production, keyword co-occurrence analysis, institutional affiliations, and relevant authors. The methodology adopted provides a reliable and systematic structure for understanding the research performance, changes, and intellectual framework of scholarly literature on data privacy and cybersecurity in libraries.

1.6. Analyses and Interpretations

1.6.1 Annual Scientific Production

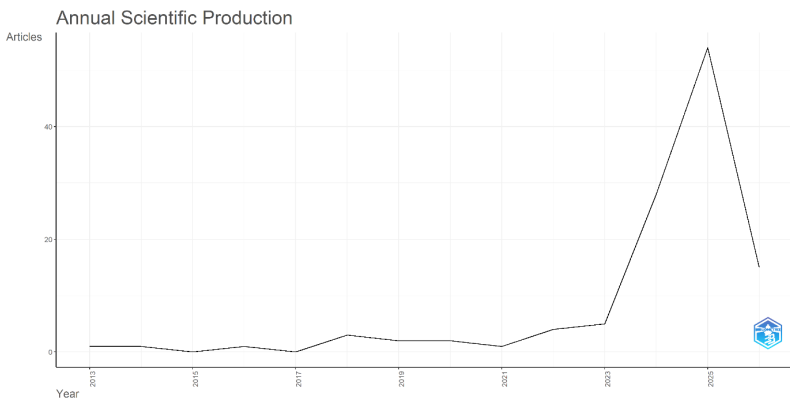


Figure 1: Annual Scientific Production

Figure 1 presents the publication growth in the area of data privacy and cybersecurity in libraries over the years. The growth shows a relatively slow and stable growth in the early years from 2013 to around 2017. During this time the publication numbers remained minimum decreasing between 0 to 1 article per year, which shows that the topic was still developing and had not yet gained essential scholarly attention. There is a slight growth from the year 2018 to 2021. A significant growth occurred from 2022 onwards, with a steady rise in the number of publications. In 2025, the number of publications increased dramatically. This outcome reveals that the topic is gaining importance and influencing through the quick digital transformation of libraries by relying on e-resources and increasing concerns about protection and cyber threats in information systems. In recent years, the number of publications has been increasing, and the topic is developing the area of research.

1.6.2. Average Citations Per Year

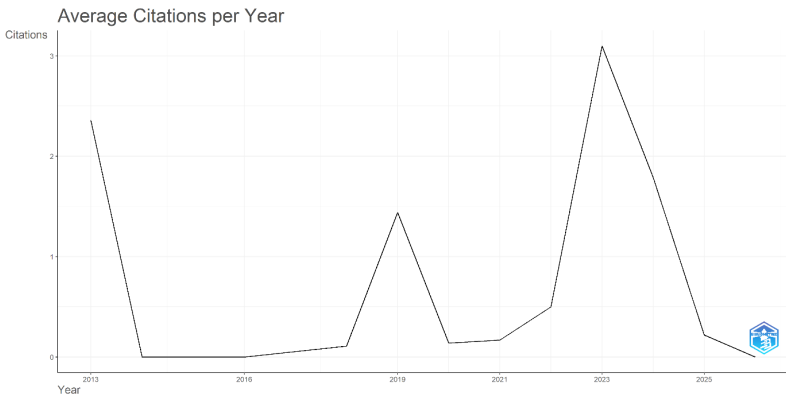


Figure 2: Average Citations per Year

Figure 2 demonstrates the Average Citations per Year. In the starting stage of 2013, the average citation was high. The average citations became zero in the years between 2014 to 2016. It was due to a low-level publication. It was also shown that a stage where the research area was still increasing and had not yet gained continuous scholarly commitment. As the number of

publications increased in the year 2017, there was a moderate rise in the citations. The average citations reached the highest level in the year 2023, and in 2024 there was a decline. Overall trend shows that the citation impact in this area has been inconsistent, mainly in recent years, there are clear periods on high influence. This shows that data privacy and cybersecurity in libraries are attaining scholarly effectiveness, with certain years producing highly cited and impactful research contributions.

1.6.3. Most Relevant Authors

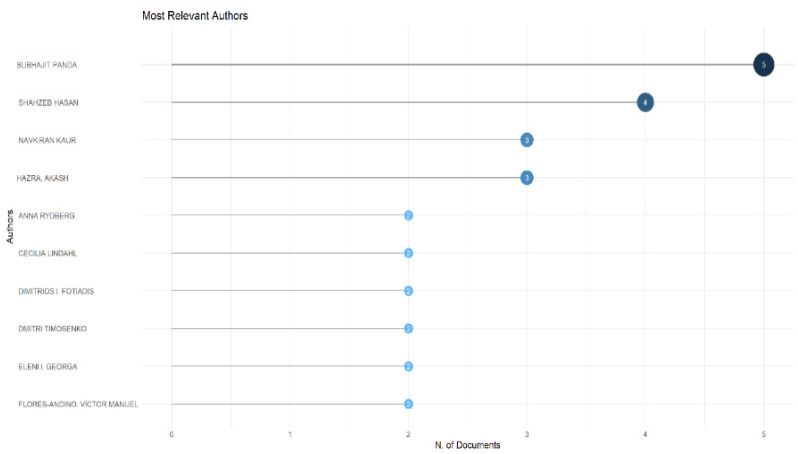


Figure 3: Most Relevant Authors

Figure 3 on Most Relevant Authors shows that, based on the number of publications, it highlights the leading contributions to the research area of data privacy and cybersecurity in libraries. With the highest number of 5 publications, Subhajit Panda stands out as the most prolific author. The second most productive author is Shahzub Hasan with 4 publications presenting the eminent engagement and scholarly contributions to the field. Hazra, Navkiran and Akash contributed 3 publications and the remaining authors, including Eleni I Georga, Cecilia Lindahl, Anna Rydberg, Flores, Victor Manuel, and Dimtrios, each have contributed 2 publications. The authorship pattern suggests that

in their domain of research, there are not many authors, and it shows that an increasing research area where participation is widening, and new contributions are constantly entering the field, thereby expanding the scope and diversity of research in data privacy and cybersecurity in Libraries.

1.6.4. Country Production Over Time

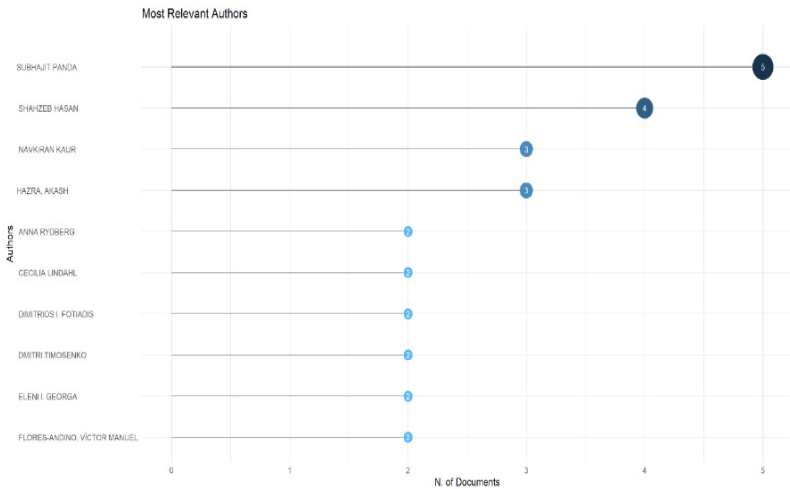


Figure 4: Country Production over Time

Figure 4 presents the output of country production over time in the domain of data privacy and cybersecurity in libraries from 5 countries: India, Indonesia, Kazakhstan, Nigeria and the USA. The output indicates that research productivity in this field remained very low until 2022, showing that this domain was an emerging area with limited scholarly attention. From 2024 onward, there was an increase in the growth of publications. Among these 5 countries, the United States presents the highest research productivity over the period. After a slow increase between 2021 and 2024, the USA experienced a sharp rise in publications, which shows the country's broad and strong research infrastructure. After 2024 onwards, Indonesia also shows considerable growth, which shows that there was

research focus in the domain of data privacy and cybersecurity in libraries. Overall, there was an upward growth in this domain. The growth and development of publications reflect the impact of cyberthreats, user privacy, and digital information protection. The USA remains the leading contributor while India, Indonesia, Kazakhstan, and Nigeria show a balanced increase, showing the increasing international relevance of this research domain.

1.6.5. Most Global Cited Documents

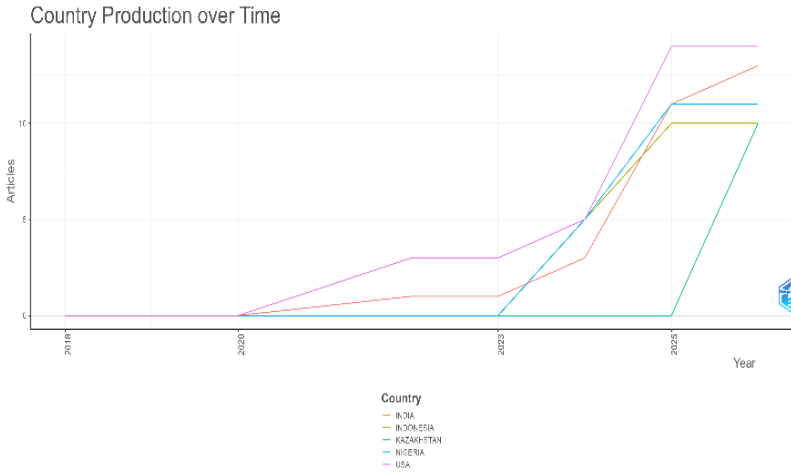


Figure 5: Most Globally Cited Documents

Figure 5 on Most Globally Cited Documents shows that the author Guma Ali's documents were the most cited, with 60 citations, which indicates that they have an immediate and strong influence in the field despite their latest publications, followed by 42 citations by Habib Ullah Khan and 33 citations by Andrei Soldatov, both with recent high-impact contributions. With other contributions by Bharath Sudharsan with 16 citations and Malik Sallam with 10 citations. The latest studies are getting more visibility, and as a result, the number of citations is growing. Many highly cited recent studies suggest developing research activity and fat knowledge in the domain of data privacy and cybersecurity in libraries.

1.6.6. Keyword Occurrences

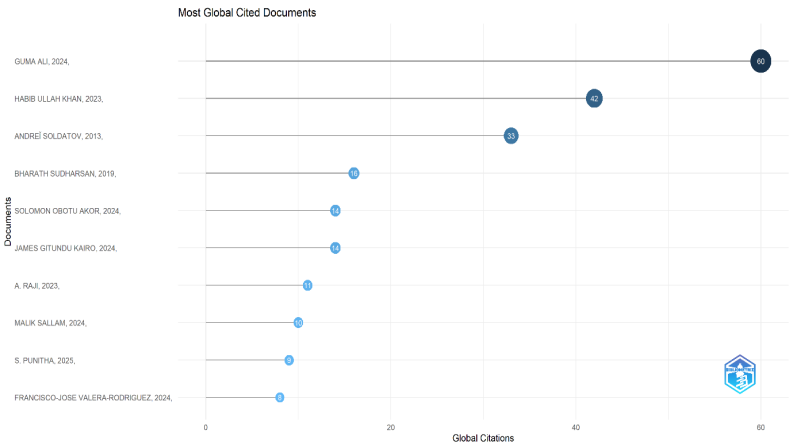


Figure 6: Frequency of occurrence of Keywords

Figure 6 demonstrates the Frequency of occurrence of Keywords, highlighting the important themes in the datasets. With 88 occurrences, data privacy, which is the theme of the study, reflects that it is the main focus of the research. This is followed by computer security (69) and cybersecurity, indicating a strong focus on security-related concerns alongside privacy. A second group of keyword occurrences is World Wide Web (18), Information Privacy (17), Internet privacy and Artificial Intelligence (16), showing the connection of privacy issues with Web technologies and emerging AI applications. Data mining occurred 9 times. The chart very clearly demonstrates that the research is mainly concentrated on data privacy and security and also increasing the domains in interdisciplinary and technology advancements, presenting the current and global concerns about data protection in the digital age.

1.6.7. Most Cited Countries

Most Cited Countries		
Country	Total Citation	Average Article Citations
North America	94	2.10

Uganda	68	34.00
Qatar	42	42.00
Nigeria	18	3.60
INDIA	17	0.80
USA	17	1.30
Kenya	14	7.00
Switzerland	14	14.00
United Arab Emirates	10	5.00
Spain	8	8.00
France	6	3.00
Japan	4	2.00
Afghanistan	3	1.50
Saudi Arabia	2	1.00
Bahrain	1	1.00
Hong Kong	1	1.00
Indonesia	1	0.30

Table 1: Most Cited Countries

Table 1 demonstrates the data of the most cited countries. North America is the top with 94 citations; it has a strong influence and research output in the field. However, its comparatively low average article citation (2.1) suggests that while the volume of publications is high, individual articles may receive moderate attention. In disparity, the countries of Qatar and Uganda show remarkably high average article citations with 42 and 32, respectively. This shows that although these countries may have few publications, their research trends have a significant impact and are highly cited, followed by Switzerland and Spain, which also indicate strong average citation values, presenting the quality and influence of their scholarly contributions. The countries like India and the USA, despite having important total citations (17 each), demonstrate lower average article citations (0.8 and 1.3, respectively), which shows that their research output is relatively less cited on a per- article basis. Overall, the findings indicate a clear difference between the high-volume contributions and high-impact contributors. There is a varied nature of global research

contributions in the field, and emphasizes the importance of both quantity and quality in scholarly impact.

1.6.8. Author Productivity through Lotka's Law

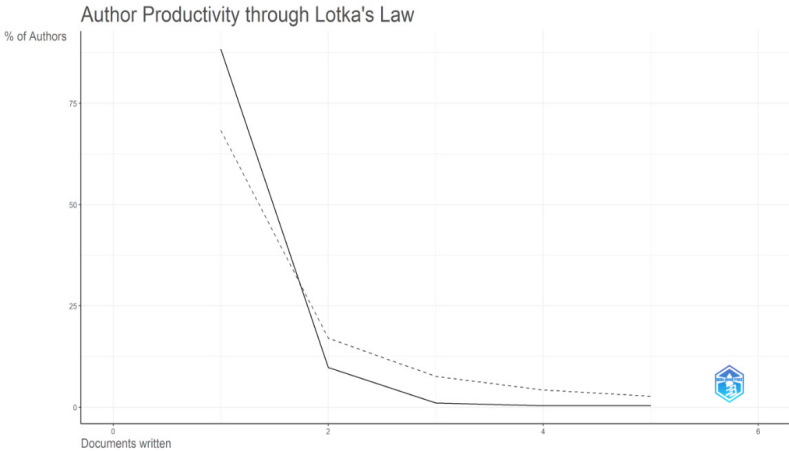


Figure 8: Author's productivity through Lotka's law

Figure 7 presents the author's productivity through Lotka's law, showing the distribution of authors based on the number of documents they have produced, comparing the observed data with the theoretical expectation. It clearly indicates that a very high proportion of authors, nearly 85-90%, have contributed only one publication, which strongly aligns with the main principle of Lotka's Law, that most of the researchers publish only a single paper. As the number of documents increases, the authors' percentage decreases sharply. Comparing the observed data with the theoretical curve, the real distribution shows steeper slopes mainly between one and two publications. This suggests that in this research filed productivity of authors is even more concentrated than predicted by Lotka's law. For higher publication counts (three or more documents), the observed values fall below the theoretical line, indicating that prolific authors are relatively rare in this dataset. This reflects a field where sustained research contribution is limited to a small group of

scholars, while the majority participate only occasionally. Overall, the chart confirms the general applicability of Lotka's Law but also highlights a stronger skew toward low-productivity authors. This pattern suggests that the research domain is characterized by a broad base of occasional contributors and a narrow core of highly productive researchers, which is typical of many emerging or interdisciplinary fields.

1.7. Conclusion

The study presents a comprehensive summary of the research trends in data privacy and cybersecurity in libraries between the years covering 2010 to 2026. The output clearly shows the domain has grown from a moderately underexplored area into a quickly growing and important field of scholarly inquiry, mainly in recent years. There was rapid growth in publications after 2022, which reflects the fast-tracking digital transformation of libraries and the increasing concerns, mainly the protection of user data and information systems. Early research output was limited; the number of publications has increased in recent years. In certain years, the citations were decreased, but in other years, there were high citations. The authorship is still developing, with the majority of the researchers contributing with a single publication, reflecting that this field is increasing and attracting new scholars. There was a limit in international collaborations, which is slowly expanding. The keywords such as data privacy, computer security, and cybersecurity are the most prominent keywords and occurred several times. At the outset of the study shows that data privacy and cybersecurity in libraries are a dynamic and developing research area with expanding worldwide relevance. There was a requirement for strong data protection frameworks, ethical data management practices and strong cybersecurity measures to become more critical as libraries continue to adopt digital technologies. The outcomes of the study not only contribute to understanding the present research landscape but also give a foundation for future discoveries, policy development, inspiring deeper teamwork, and creative solutions to address the complex challenges in this field.

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CARBON FOOTPRINT OF CLOUD-BASED LIBRARY SYSTEMS: A FRAMEWORK FOR SUSTAINABLE GREEN DIGITAL LIBRARIES

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Abstract

The rapid migration of academic libraries in South India to cloud-based Library Management Systems (LMS) and digital repositories has enhanced accessibility but introduced significant environmental externalities. While digital services are often perceived as eco-friendly, the energy consumption of underlying data centers contributes substantially to global carbon emissions. This study investigates the awareness and practices regarding the carbon footprint of cloud-based library systems among college librarians in South India. A descriptive survey method was employed using a structured questionnaire administered to 30 college librarians across various states. Data analysis reveals a critical gap: while 86% of respondents utilize cloud-based services, only 40% possess general awareness, and a mere 17% demonstrate specific technical understanding of the associated environmental

costs, and none incorporate sustainability metrics in vendor selection. Based on these empirical findings, the paper proposes a four-pillar framework for Sustainable Green Digital Libraries, encompassing green procurement, data hygiene, user awareness, and renewable energy advocacy. The study concludes that integrating environmental accountability into digital library management is essential for aligning academic institutions with global sustainability goals. This framework offers actionable strategies for librarians to mitigate the hidden carbon costs of digital transformation.

Keywords: Green Libraries; Cloud Computing; Carbon Footprint; Sustainability; Digital Libraries; Academic Libraries; South India

1. Introduction

The academic library landscape in India is undergoing a profound digital transformation. Driven by the National Education Policy (NEP) 2020 and the increasing demand for remote access to information, college libraries across South India are rapidly migrating from traditional physical infrastructures to cloud-based Library Management Systems (LMS), digital repositories, and e-resource platforms (Singh & Sharma, 2024). This shift has enhanced service delivery, enabling students and faculty to access scholarly resources beyond physical and temporal boundaries (Kumar & Patel, 2023). However, as the profession embraces these technological advancements, it is imperative to consider the environmental implications of digital infrastructure.

While digital libraries are often perceived as “paperless” and therefore environmentally friendly, this perception overlooks the significant energy consumption required to sustain them. Cloud-based systems rely on massive, geographically distributed data centers that operate continuously, requiring substantial electricity for server operations, data transmission, and cooling systems (Belkhir & Elmeligi, 2023). According to recent global estimates, the Information and Communication Technology (ICT) sector contributes approximately 2–4% to global carbon emissions, comparable to the aviation industry (International Energy Agency [IEA], 2024). In the context of South India’s

higher education sector, where hundreds of colleges adopt cloud solutions simultaneously, the cumulative carbon footprint of these digital systems becomes a critical concern (Thomas & George, 2025).

Despite growing emphasis on sustainability in physical library buildings such as energy-efficient lighting and waste management (IFLA, 2023) the “digital carbon footprint” remains largely unaddressed in library policy and procurement decisions (Williams, 2024). Librarians often select cloud vendors based on cost and functionality, with little regard for energy efficiency or environmental certifications (Chen & Martinez, 2025). This gap poses a challenge to sustainable development in higher education (UNESCO, 2023).

1.1 Problem Statement

The core problem addressed is the hidden environmental cost of cloud-based library systems. While academic libraries support research and learning, their digital infrastructure may inadvertently contribute to climate change through high energy consumption and hardware lifecycle impacts (Freitag et al., 2023). There is limited empirical data on awareness levels among South Indian college librarians, and no standardized framework exists to guide sustainable digital practices (Reddy & Nair, 2024).

1.2 Objectives

1. To assess awareness among college librarians in South India regarding the carbon footprint of cloud-based library systems.
2. To identify current sustainable practices in digital library management within the region.
3. To propose a comprehensive framework for Sustainable Green Digital Libraries.

1.3 Relevance to Sub-Theme

This study aligns with the sub-theme Sustainable and Green Digital Libraries. Environmental sustainability must

become a core competency alongside information literacy and technology management (IFLA, 2023). By examining the environmental impact of cloud systems, this paper initiates dialogue on responsible technology procurement and usage (Williams & Thompson, 2025).

2. Methodology

2.1 Research Design

A descriptive survey method was employed to assess awareness and practices regarding the carbon footprint of cloud-based library systems.

2.2 Population and Sample

The target population comprised college librarians in South India (Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Telangana). A purposive sampling technique was used to select 30 respondents representing government, aided, self-financing, and autonomous institutions.

2.3 Data Collection Tool

A structured questionnaire was developed with four sections:

- Section A: Demographic profile (4 items)
- Section B: Cloud infrastructure usage (5 items)
- Section C: Awareness of carbon footprint (5 items)
- Section D: Current sustainable practices and barriers (7 items)
- Section E: Framework development input (6 items)

Questions utilized multiple-choice, Likert-scale (1–5), and open-ended formats. The questionnaire was validated by two library science experts and pilot-tested with five librarians.

2.4 Data Collection Procedure

The questionnaire was administered via Google Forms between March 25 to April 10, 2026. Responses were collected

anonymously with informed consent. Of 45 invitations sent, 30 complete responses were received (67% response rate).

2.5 Data Analysis

Quantitative data were analyzed using descriptive statistics (frequencies, percentages, mean scores) in Microsoft Excel. Qualitative responses from open-ended questions were thematically coded. Results are presented through tables and charts for clarity.

3. Data Analysis and Discussion

3.1 Demographic Profile of Respondents (N=30)

Variable	Category	Frequency	Percentage
State	Kerala	12	40%
	Tamil Nadu	7	23%
	Karnataka	6	20%
	Andhra/Telangana	5	17%
Institution Type	Government	9	30%
	Aided	8	27%
	Self-Financing	9	30%
	Autonomous	4	13%
Experience	0–5 years	10	33%
	6–10 years	8	27%
	11–15 years	7	23%
	15+ years	5	17%

The sample reflects diverse institutional types and experience levels across South India, enhancing the generalizability of findings within the regional context.

3.2 Cloud Infrastructure Usage Patterns

Table 1: Cloud Service Adoption (N=30)

Question	Response	Frequency	Percentage
Use cloud-based LMS?	Yes	28	93%
	No	2	7%

Primary data host	Third-party cloud (AWS/Azure)	19	63%
	Vendor-managed server	6	20%
	Institutional server	3	10%
	Hybrid	2	7%
Duration of cloud usage	1–3 years	14	47%
	4–6 years	9	30%
	7+ years	5	17%

Interpretation: The near-universal adoption of cloud-based services (93%) confirms the digital transformation trend. However, heavy reliance on third-party clouds (63%) means libraries have limited control over the energy sources powering their data, creating a dependency that complicates sustainability efforts.

3.3 Awareness of Carbon Footprint (Objective 1)

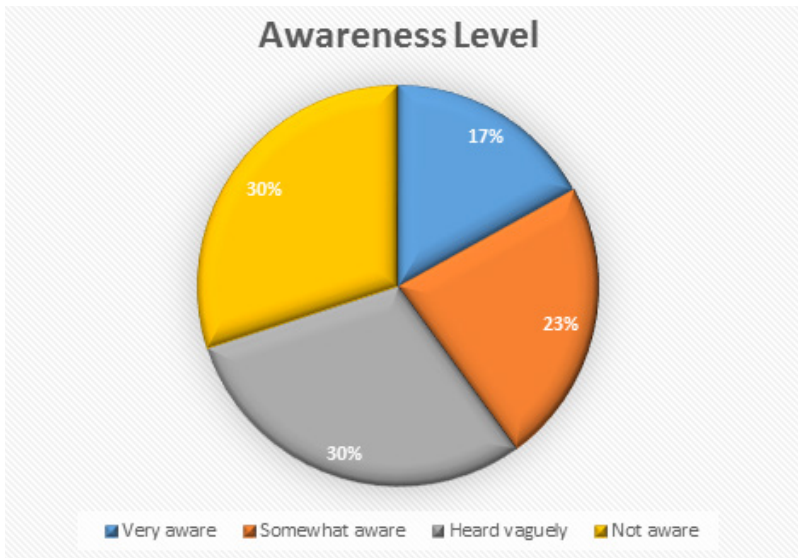


Figure 1: Awareness Levels of Carbon Emissions from Cloud Systems

Key Finding: While 40% of respondents demonstrated general awareness (combining the ‘somewhat aware’ and ‘very aware’ categories), only 17% demonstrated specific technical understanding (‘very aware’) of carbon emissions from cloud systems. This distinction indicates that while a portion of librarians recognize the general existence of a digital carbon footprint, specific technical understanding regarding how activities like data transmission and server cooling contribute to emissions remains critically low. The mean understanding score on a 5-point scale was 2.4 (SD=1.3), indicating generally low knowledge levels.

Table 2: Awareness of Specific Carbon-Contributing Activities

Activity	Aware (Yes)	Not Aware (No)
Data storage in cloud servers	73%	27%
Data transmission over networks	53%	47%
24/7 server cooling systems	67%	33%
Digital file downloads/streaming	40%	60%
E-waste from outdated hardware	60%	40%

Interpretation: Awareness is highest for tangible concepts like data storage and cooling but lowest for less visible activities like data transmission and downloads. This suggests librarians understand infrastructure-level impacts but not usage-level contributions.

3.4 Current Sustainable Practices (Objective 2)

Table 3: Implementation of Green Practices (N=30)

Practice	Yes	No	Percentage Yes
Delete unused/duplicate digital files	14	16	47%
Energy-saving settings on devices	20	10	67%
LED lighting in library	18	12	60%
Server virtualization	8	22	27%
Paperless workflows	15	15	50%
User awareness programs on sustainability	12	18	40%
Monitor digital storage usage	10	20	33%
None of the above	2	28	7%

Interpretation: Basic practices like energy-saving settings (67%) and LED lighting (60%) show moderate adoption. However, advanced strategies like server virtualization (27%) and storage monitoring (33%) remain underutilized. Only 7% reported implementing no practices, indicating baseline environmental consciousness.

Vendor Selection Priorities: When ranking criteria for selecting cloud vendors, sustainability ranked lowest:

- Cost: Mean rank 1.8 (highest priority)
- Features/Functionality: 2.3
- Data Security: 2.9
- Energy Efficiency/Sustainability: 5.4 (lowest priority)

Critically, **0% of respondents** reported “always” considering environmental credentials in vendor selection, while 70% stated they “never” do so. This confirms a significant gap between cloud adoption and sustainable procurement.

3.5 Barriers to Sustainable Practices

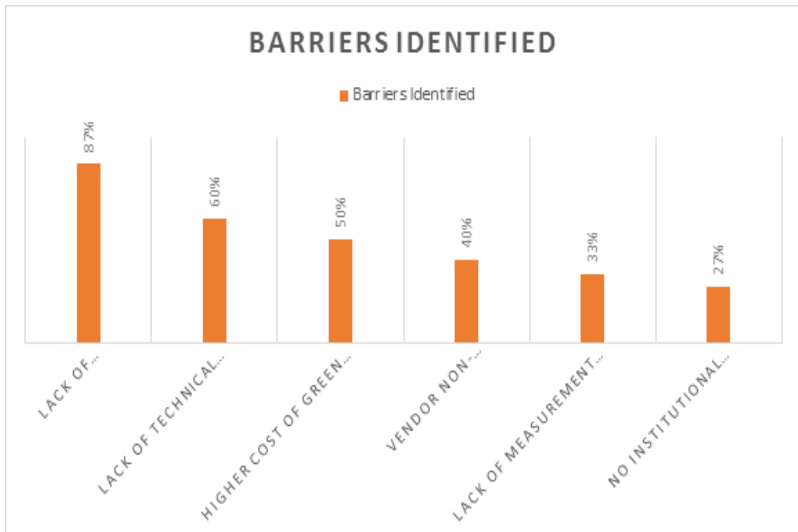


Figure 2: Top Barriers Identified (Select Top 3)

Interpretation: The overwhelming identification of “lack of awareness” (87%) as the primary barrier validates the need for capacity-building initiatives. Cost concerns (50%) and technical expertise gaps (60%) further highlight systemic challenges requiring multi-level interventions.

3.6 Demand for Framework Components (Objective 3)

Table 4: Perceived Importance of Framework Components (Scale: 1–5)

Component	Mean Score	Interpretation
User Awareness Programs	4.4	Highest demand
Green Procurement Guidelines	4.3	High demand
Carbon Footprint Measurement Tools	4.2	High demand
Data Hygiene Protocols	4.1	High demand
Green Vendor Certification Database	3.9	Moderate-High
Renewable Energy Advocacy	3.6	Moderate

Interpretation: All components received mean scores above 3.5, indicating strong interest in structured support. “User Awareness Programs” ranked highest, suggesting librarians recognize the importance of community engagement in sustainability efforts.

Adoption Intent:

- 53% would “definitely” adopt a Green Digital Library Framework
- 27% would adopt “with modifications”
- 63% expressed willingness to participate in pilot testing

This positive reception indicates readiness for professional association-led initiatives.

4. Proposed Framework for Sustainable Green Digital Libraries

Based on empirical findings, this paper proposes a four-pillar framework actionable for South Indian academic libraries:

Pillar 1: Green Procurement Guidelines

Rationale: 70% of respondents never consider sustainability in vendor selection due to lack of criteria and transparency. **Actions:**

- Develop a standardized checklist for evaluating cloud vendors' environmental credentials (e.g., renewable energy usage, Carbon Usage Effectiveness ratings)
- Prioritize vendors with certifications like Energy Star, EPEAT, or ISO 14001
- Include sustainability clauses in service-level agreements (SLAs)
- Create a regional database of pre-vetted “green” vendors for libraries

Pillar 2: Data Hygiene and Optimization Protocols

Rationale: Only 47% regularly delete unused files; storage optimization directly reduces energy consumption. **Actions:**

Implement quarterly audits to identify and archive/delete redundant digital content

- Establish retention policies for temporary files and outdated resources
- Adopt compression techniques for large digital collections
- Monitor storage usage through automated dashboards

Pillar 3: User Awareness and Capacity Building

Rationale: 87% identified lack of awareness as the primary barrier; user behaviour significantly impacts digital carbon footprint. **Actions:**

- Integrate sustainability modules into library instruction programs
- Develop infographics and guides on “green digital practices” for students/faculty

- Conduct workshops for library staff on energy-efficient digital workflows
- Promote mindful downloading and streaming practices among users

Pillar 4: Renewable Energy Advocacy and Measurement

Rationale: Mean interest score of 3.6 indicates moderate readiness for energy transition initiatives. **Actions:**

- Advocate for institutional adoption of solar power for library server rooms
- Partner with cloud providers offering renewable energy options
- Implement basic carbon footprint calculators for digital services
- Publish annual “digital sustainability reports” to track progress

5. Challenges and Recommendations

5.1 Implementation Challenges

1. **Budget Constraints:** Green-certified vendors may have higher upfront costs; sustainability initiatives compete with other library priorities.
2. **Technical Capacity:** Librarians lack training in carbon accounting and green IT practices.
3. **Vendor Transparency:** Limited disclosure of energy data by cloud providers hinders informed decision-making.
4. **Measurement Gaps:** No standardized, library-specific tools exist to quantify digital carbon footprints.
5. **Institutional Alignment:** Sustainability policies may not exist at the college level, limiting library-level action.

5.2 Recommendations

For Librarians:

Start with low-cost, high-impact actions like data hygiene and user awareness

Collaborate with IT departments to access energy consumption data

Document and share green practices through professional networks

For Institutions:

Integrate digital sustainability into campus-wide environmental policies

Allocate seed funding for green library initiatives

Recognize and reward sustainable practices in library evaluations

For Cloud Vendors:

Publish transparent environmental impact reports

Offer tiered pricing for renewable energy-powered services

Develop library-specific sustainability dashboards

6. Conclusion

This study reveals a critical paradox in South India's academic libraries: widespread adoption of cloud-based systems coexists with limited awareness of their environmental impacts. While 93% of respondents utilize cloud services, only 40% demonstrate general awareness, and a mere 17% possess specific technical understanding of associated carbon emissions, and sustainability remains absent from vendor selection criteria. These findings underscore an urgent need to integrate environmental accountability into digital library management.

The proposed four-pillar framework Green Procurement, Data Hygiene, User Awareness, and Renewable Energy Advocacy

offers actionable pathways for librarians to mitigate the hidden carbon costs of digital transformation. Strong interest in framework adoption (80% positive intent) indicates readiness for professional association-led initiatives.

As academic libraries continue to evolve as digital hubs, sustainability must become a core professional competency alongside information literacy and technology management. By adopting green digital practices, libraries can align technological progress with ecological responsibility, contributing to institutional and global sustainability goals. Future research should focus on developing library-specific carbon measurement tools and conducting longitudinal studies to assess framework implementation outcomes.

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TRANSFORMING LIBRARIES TO INCLUSIVE AND ACCESSIBLE SPACE FOR TRANSGENDER COMMUNITY

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Abstract

This research investigates how libraries may develop into genuinely inclusive and accessible venues for transgender people, as well as the necessity of transgender inclusion in library settings. The study emphasizes the ongoing marginalization and information obstacles experienced by transgender people by drawing on a descriptive review of the body of research on equity, diversity, and accessibility in libraries.

It challenges the conventional idea of library neutrality, arguing that rather than resolving systematic injustices, it instead helps maintain them. Key structural and sociocultural impediments are identified in the study, such as discriminatory knowledge organization systems, a lack of inclusive policies, insufficient staff training, and low representation in collections. It highlights the significance of gender-sensitive services, inclusive metadata, and the availability of trustworthy information on identification, legal rights, and health. The article also suggests practical tactics including community involvement, staff awareness, policy changes, and the development of secure physical environments like gender-neutral facilities. In the end, it presents libraries as transforming establishments that, by actively adopting diversity and social justice values, can support transgender people's empowerment, dignity, and sense of belonging.

Keywords: Libraries, Inclusion, Accessibility, Transgender Community, Gender Expression

1. Introduction

The term transgender is an umbrella term that represents people who exhibit gender expressions that differ from their biological sex and do not fit in with social norms (Coleman et al., 2012). Transgender people are very vulnerable minority group in our society. They are socially excluded and considered outcasts because of their gender (Anbukarasi & Sony, 2025). In every realm of their life, they have to encounter with marginalization and oppression. Along with this they experience high level of mental distress due to the social exclusion (James et al., 2016).

Libraries are meant to be accessible for all without any discrimination. According to the definition of ALA (2008), libraries are the institutions functioning with an aim to serve the society as a whole (ALA, 2010). But in contrast to this transgender people experience gender bias in library (Keralis, 2023). They neither feel safe in using library nor feel comfortable with the library staff (Leuzinger et al., 2020). Lack of an inclusive library policy, adequate resources, gender neutral reading area and washroom facilities, and behaviour of library staffs all

contribute to this. Transgender people have their own specific information needs regarding changes of their body, health, legal rights etc. Library should be able to provide them this information and make them easy to access. Even if the library does not have all the needed resources the librarian should be able to support and guide them to the right sources (Drake & Bielefield, 2017). Libraries should become a place of inclusive knowledge dissemination and provide support to transgenders in empowering them.

The present study aims to explore how libraries can become more inclusive rather than functioning in the traditional norm of so called “neutrality and accessibility”. It also discusses about the changes need to be adopted by the library regarding various policies and frameworks, proper staff training, preparing inclusive metadata and subject headings, and creating a welcoming physical environment. The significance of having a collection that show transgender representation is also marked in the study. Going through the concept of access, representation and belonging the study states library as a transformative space that serve all members of the community with dignity and respect.

2. Review of Literature

Transgender individuals felt excluded in many aspects of their life. Our aim should be to create an inclusive society for all without any discrimination (Saminathan & Pillai, 2025). The inclusive environment provided for them in different arenas of society will provide them a feeling of belongingness, and will eventually create a protective effect (Poliwoda et al., 2025). Drake and Bielefield (2017) conducted a study on providing equitable access for transgender patrons in library. The analysis revealed that transgender patrons found it welcoming and comfortable when the libraries have collections that represent their community, subject headings that can retrieve transgender related literature easily, and gender-neutral reading rooms and washrooms. It was also noted that having a supportive staff and policies to express their identity and expression give them an inclusive feeling. The

study reveals that having a easier name changing process and addressing them without any salutations in libraries will be more comfortable for transgender patrons. With the global attention getting on the topic many libraries worldwide started to consider these inclusion efforts practically. The inclusion efforts made by the libraries in Illinois was assessed in the study of Ness (2024). Defects of not having proper markers for the inclusion criteria that make the environment of library somewhat inclusive was notable. The need of new normative framework, new policies, and change in the attitude of library professionals were pointed out in this study too. The study of Krueger and Matteson (2017) provide directions on how library professionals should work for the better inclusion of transgenders. The article studied about educating library professionals for providing inclusive facilities and services to transgender patrons. Library professionals should undergo regular workshops and training related to transgender patrons as lack of knowledge is the primary reason of neglecting the needs of other gender people. According to the study, it is really important to ensure that while providing information services to transgender patrons it comes from an authentic source and also really significant to the time. While addressing the previously noted factors like availability of gender-neutral restrooms, policy frameworks, representative collection etc. the study highlight the point that reaching out to the transgender community and having a better contact with them is a necessity to ensure their participation and also understanding their needs.

3. Objectives of the study

- To examine the need for transgender inclusion in libraries by assessing their information needs.
- To critically examine the limitations of the traditional notion of library neutrality in addressing the needs of transgender users and to explore how this concept may inadvertently perpetuate exclusion.
- To analyze the structural and socio-cultural barriers that hinder transgender individuals' access to library

spaces and services.

- To investigate the role of knowledge organization systems, including metadata and subject headings, in shaping the visibility and accessibility of transgender-related information.
- To explore how libraries can adopt inclusive policies, practices, and frameworks that address the specific informational, social, and psychological needs of transgender communities.

4. Methodology

The study chooses descriptive analysis and is based on detailed exploration of secondary sources, mainly journal articles published in the field of ‘transgender inclusion’, ‘equity and diversity’ and ‘accessibility in libraries’ available in the Scopus database. The search was conducted using the query “transgender AND library AND (inclusion OR inclusive)” in the Title-Abstract-Keyword field. The initial search retrieved 88 documents from 2001 to 2026. A screening process was done by manually reviewing title and abstract of the study to ensure the relevancy of documents to our study. Studies that directly addresses transgender inclusion in libraries, accessibility of gender-diverse people in libraries, equity and diversity were considered. The final dataset after applying this inclusion criteria included 18 documents.

5. Need of Transgender Inclusion in Libraries

Libraries as a public institution need to provide access to all. In the case of transgender individuals, the access alone is not sufficient, they should get the inclusive feeling. Often oppressed and discriminated by the society, to felt the belongingness is essential for them to reach out to the library. Transgender individuals have specific information needs mainly regarding medical and legal aspects (Drake & Bielefield, 2017). Unfortunately, most of them is not knowledgeable enough about authentic and reliable sources to get this information. Library is

the place they can depend on for authentic information. They will also prefer to get more fictions and non-fiction works of transgender people or on transgender people. Library and library professionals should have knowledge about their particular information need in general. And should make sure that they are able to access this information comfortably.

6. Rethinking the Traditional Notion of ‘Library Neutrality’

The traditional notion of library neutrality comes in the major discourse while talking about accessibility and inclusive library services. Often neutrality is considered as a commitment to impartiality and equal access, while in reality it is just a way to maintain the status quo. Saying that library is for everyone, yet failing to address the issues of inequality, is still a form of exclusion. Library should not function with the assumption that all users operate within the same social and cultural conditions. Gender minority people experience systemic marginalization that shapes their access to information, safety, and participation in public spaces. By treating all users as equal without acknowledging these structural inequalities, neutrality fails to recognize the specific barriers faced by transgender communities.

Regarding the context of gender, cisnormative assumptions are embedded within library practices. It is clearly evident in every function of library, from collection development to user interactions. The lack of collections that satisfy their needs, the absence of a third-gender column on an application form, and the unavailability of gender-neutral restrooms—which are normally overlooked due to societal norms—all come under the category of exclusion. Classification schemes, subject headings, and cataloguing practices too have reflected dominant cisnormative perspectives, often using outdated or stigmatizing terminology for transgender identities. This approach ignores the need for equity-based interventions that address the unique vulnerabilities of transgender users. It also allows discriminatory behaviors, such as misgendering or harassment, to go unaddressed if they are not

explicitly recognized as institutional concerns. More active and reflective understanding of the library's role in society is needed to change this pattern. A shift from neutrality to a framework grounded in equity and social justice is therefore essential for meaningful transgender inclusion in libraries.

7. Barriers to Accessibility

The structural barriers mainly include the lack of policies that recognize and protect gender-diverse users. The membership forms, identity verification procedures, and databases will require legal identity proof, which may not be in align with their self-identified identity. This may create discomfort, force unwanted disclosure of identity, or even leads to lose interest in visiting library altogether. The infrastructural limitations will make transgender users feel unsafe or scrutinized because of the gender segregated facilities, which in turn make library physically unwelcoming.

Apart from these, the prevailing social stigma and prejudice against gender minority people creates the socio-cultural barrier. Discriminatory attitudes or actions by other users may contribute to an unpleasant environment. Lack of awareness or sensitivity among library staff may create situations where transgender individuals are felt avoided or disregarded. Such situations can lead to create uncomfortable interactions. Traditional norms can have an impact on institutional decision-making, which can often lead to reluctance to the implementation of inclusive policies and services. Together, these structural and socio-cultural barriers, restricts not only the physical access, but also the sense of belonging in the library environment.

8. Knowledge Organization Systems Reframed for Transgender Access and Visibility

The accessibility of which transgender-related content may be found, accessed, and comprehended inside library systems is largely dependent on knowledge organization systems (KOS), which consist of metadata, classification schemes, and subject

headings. Many of these systems have historically been influenced by prevailing cisnormative viewpoints, which frequently leads to language that is out-of-date, incorrect, or even stigmatizing. These constraints not only make it more difficult to access information, but they also contribute to the marginalization of transgender identities by making them invisible or inaccurately represented in databases and catalogues. It might be challenging for users to find appropriate materials when incorrect subject headings or inclusive descriptors are used, which limits fair access to information. Libraries must critically assess and update their metadata processes in order to address this, using vocabulary that is professional, up to date, and community-informed. To improve representation, it is crucial to implement inclusive vocabulary, update categorization standards, and make sure indexing procedures are flexible. By doing this, information organization systems can actively promote transgender identities' visibility, accessibility, and affirmation in library settings, moving beyond passive structures.

9. Adopting Inclusive Policy frameworks and Practices

By purposefully attending to the various informational, social, and psychological requirements of transgender groups, libraries can implement inclusive policies, practices, and frameworks. The first step in doing this is to create explicit anti-discrimination guidelines that acknowledge gender diversity and provide courteous, secure access to library services. Legal identity disclosure should be minimized by allowing self-identified names and genders in administrative procedures like membership registration. In order to guarantee that people have access to trustworthy information on social issues, legal rights, and health, libraries should also make investments in creating inclusive collections that feature transgender voices and experiences in both fiction and non-fiction. In order to promote good and courteous interactions with transgender users, staff training programs are crucial for developing sensitivity, awareness, and competence. Comfort and safety can also be greatly increased by designing inviting physical spaces, such as gender-neutral restrooms and

inclusive signage. Libraries can better understand the needs of their patrons and promote involvement through outreach programs and collaborations with transgender populations. Libraries can go beyond symbolic inclusion and actively promote the empowerment, well-being, and dignity of transgender people by combining these strategies into a coherent framework.

Given below are some public libraries that the already established inclusive facilities to support the transgender community.

New York Public Library: Started LGBTQ initiatives to support lesbian, gay, bisexual, transgender and queer communities. Conduct different outreach programme for them. Have different resources and services provided. Also have special collection on AIDS crisis affected by these communities (“LGBTQ initiative”, n.d.).

San Francisco Public Library: Established the James C. Hormel LGBTQIA+ Center. It is the collection documenting lesbian, gay, bisexual, transgender, queer, questioning, intersex, asexual and allies’ history and culture, with a special emphasis on the San Francisco Bay Area (“James C. Hormel LGBTQIA Center”, n.d.).

National Library of New Zealand: In 2022 updated its metadata terms and included terms like ‘trans sexual’, ‘transgender’, etc. (“Transsexual people”, n.d.).

10. Transgender-Inclusive Library Implementation and Promotion Challenges

1. Insufficient Inclusive Policies and Administrative Obstacles

It is challenging to accommodate self-identified gender identities due to strict registration procedures, ID requirements, and unclear anti-discrimination regulations.

2. Inadequate Awareness and Training for Staff

Misgendering, disrespectful behavior, and unwanted interactions can result from library staff’ lack of awareness of gender diversity.

3. *Infrastructure and Financial Limitations*

Initiatives for training, updated collections, inclusive places, and gender-neutral facilities are all limited by financial constraints.

4. *Outdated Systems for Organizing Knowledge*

Access to relevant information is limited by the use of stigmatizing or non-inclusive language in traditional metadata, classification, and subject headings.

5. *Limited Access to Inclusive Resources*

Both representation and information access are impacted by an absence of genuine, varied, and locally relevant transgender-related resources.

6. *Stigma and Socio-Cultural Resistance*

Common societal biases may impact institutional procedures and produce a hostile atmosphere in libraries.

7. *A lack of trust because of bad experiences in the past*

Transgender people may be discouraged from using library services if they have already experienced discrimination in public places.

8. *Lack of Secure and Friendly Environments*

Fear of harassment, gender-segregated facilities, and a lack of inclusive signs all diminish a person's sense of security and community.

9. *Limited Representation and Visibility in Library Services*

Transgender users may feel left out or ignored if they are not represented in collections, programs, and outreach initiatives.

10. *Insufficient Outreach and Service Awareness*

Low awareness and participation in the resources and services offered by libraries are caused by inadequate engagement with transgender communities.

11. Key Findings and Suggestions

Libraries Are Less Effective Without Inclusion

The study concludes that for transgender users, formal or physical library access is insufficient. Transgender people are less likely to use library services if they don't feel comfortable, respected, and included, emphasizing the need for inclusion beyond accessibility.

Conventional Library Neutrality Maintains Inequality

Although neutrality is meant to guarantee equal treatment, it frequently overlooks structural inequalities as a result, transgender users are inadvertently left out and their unique requirements are not met by cisnormative norms.

Socio-Cultural and Structural Barriers Limit Participation Significantly

Transgender people's use of library spaces is limited by physical and psychological barriers such strict administrative procedures, a lack of gender-neutral facilities, and social judgment.

Knowledge Organization Systems Affect Access and Visibility

The discoverability of transgender-related resources is reduced by outdated and non-inclusive metadata, subject headings, and classification systems, which limits efficient information search and promotes invisibility.

Inclusive Practices and Policies Boost Empowerment and Involvement

Libraries that implement inclusive frameworks—such as community outreach, gender-sensitive infrastructure, representative collections, and staff training—are better at fostering welcoming spaces that promote transgender users' social, psychological, and informational well-being.

12. Conclusion

According to the study's findings, real inclusion in library settings requires a fundamental change from conventional ideas of neutrality to a framework that is equity-driven and socially

sensitive. Transgender people still face substantial structural, informational, and sociocultural obstacles that restrict their access to and involvement in libraries, despite the fact that libraries are intended to be accessible to everybody. The results highlight that inclusion is about creating a sense of safety, dignity, and belonging rather than just having resources available. Enhancing accessibility and representation is largely dependent on key areas such as the creation of inclusive policies, staff sensitivity, gender-friendly infrastructure, and the updating of knowledge organization systems. The study also emphasizes the value of community involvement and the necessity for libraries to actively address the unique psychological and informational needs of transgender patrons. Even though obstacles like institutional resistance, social stigma, and financial limitations still exist, they are not inevitable. Libraries may become empowering places that support diversity, advance equality, and guarantee meaningful involvement for transgender people by implementing inclusive policies and reconsidering their role as social change agents.

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INFORMATION ETHICS, PRIVACY, AND SECURITY IN ACADEMIC LIBRARIES: CHALLENGES, PRACTICES, AND FUTURE DIRECTIONS

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Abstract

The current era of technology has made academic libraries evolve from their conventional function as mere information depositories to becoming centers of information having access to vast information stored in electronic media. Such progressions have introduced a variety of challenges concerning the ethics of information, confidentiality, and information security. It is the responsibility of academic libraries to preserve the values of intellectual freedom and encourage proper usage of information while also ensuring confidentiality of personal

user information. In this connection, this study gives a brief insight about the ethical problems of information and security involving academic libraries. Apart from that, the research will also delve into some of the existing actions and future plans in this regard (*IFLA Statement on Privacy in the Library Environment – IFLA*, n.d.) (Clark Hunt et al., 2023a) (Farid et al., 2025)

Keywords: Information Ethics, Privacy, Security, Academic Libraries, Data Protection, Digital Libraries

1. Introduction

Changes in academic libraries occurred owing to the adoption of digital technologies, electronic information sources, and interconnected information storage and retrieval systems (Ayinde et al., 2026). While acknowledging the benefits that have emerged from those changes, many problems arise regarding the mechanisms used to obtain, store, retrieve, and utilize information.

Information ethics can be defined as moral standards associated with the creation, dissemination, storage, and utilization of information. As far as academic libraries are concerned, ethical concerns are connected with user confidentiality, intellectual freedom, and equal access to information (Ayinde et al., 2026; Olmann & Olmann, 2017). Given that more and more users rely on digital information resources, academic libraries accumulate information about their patrons, such as browsing records, borrowed literature, and login credentials. If not controlled effectively, this information may result to breaches in user confidentiality and security (Hartman-Caverly & Chisholm, 2020). Thus, academic libraries need to ensure information access ethics.

2. Objectives of the Study

1. To understand the concept of information ethics in academic libraries.
2. To examine major security threats in digital library systems.

3. To explore ethical challenges of emerging technologies in libraries.
4. To assess awareness among users and library professionals.
5. To suggest strategies for improving ethics, privacy, and security.

3. Methodology

This study is descriptive in its nature. It is based mainly on lessons learned from watching and working with digital programs. Moreover, secondary data from scholarly journal articles were also gathered through a literature review.

This study adopted a descriptive review research design based on secondary data to examine information ethics, privacy, and security in academic libraries. Relevant literature was collected from well-known academic databases, including Google Scholar, Research Gate and websites

The study included peer-reviewed journal articles, conference papers, published in English between 2020 and 2025. Publications that were not directly related to the topic, duplicate records, non-English publications, and articles with insufficient information were excluded.

The selected literature was carefully reviewed and analyzed, current challenges, best practices, and emerging trends related to information ethics, privacy, and security in academic libraries.

4. Review Literature

This study aims at examining the ethical considerations and responsibilities involved in upholding confidentiality in Tanzanian University libraries. Using the framework of Professionalism Theory along with a multi-method research design, information Professionals (n=136) were sampled from four higher education institutions; namely, the University of Dar es Salaam, Sokoine University of Agriculture, Mzumbe University, and the University of Dodoma.

According to the findings, even though there is adherence to ethical principles like fairness and user confidentiality, there are shortcomings in terms of reliability of services, safety of data, and lack of clarity in terms of the confidentiality policies. Thus, it is concluded that although there is a high level of ethical engagement, the existence of policy lapses and their poor enforcement hinder the achievement of confidentiality (Kachota et al., 2025)

Recent research indicates that the integration of digital technologies and data analytics has intensified ethical challenges. It highlights how big data practices in academic libraries raise concerns about user surveillance and ethical data usage, calling for stronger ethical frameworks. Similarly, a systematic review by Singh and Brar (2023) identifies growing risks related to digital data privacy, including vulnerabilities in network security, RFID systems, and third-party applications (Singh & Brar, 2023)

Ethical challenges extend beyond privacy and security to include copyright restrictions, censorship pressures, and equitable access. A 2025 study found that many libraries struggle to balance privacy protection with data collection for analytics, while also facing difficulties in ensuring fair access to copyrighted materials (Agarwal et al., 2025a)

5. Concept of Information Ethics in Academic Libraries

The ethical use of information involves a wide range of issues like intellectual freedom, privacy, copyright, information ownership, and equitable access. Librarians perform a crucial function in promoting ethical uses of information by ensuring that users can access freely to information without the fear of being monitored or their data misused.

The ethical standards of libraries include:

- Safeguarding user privacy
- Encouraging neutral access to information

- Respecting intellectual property
- Being clear about how data is used

Libraries to practice ethical information policies for establishing credibility with their patrons. Libraries are not only considered sources of information but are also trusted for providing a safe environment for study and research (Clark Hunt et al., 2023b) (Agarwal et al., 2025b)

6. Privacy Issues in Academic Libraries

Privacy is among the most crucial elements of information ethics. Traditionally, privacy protection in libraries was an easier task. Today, however, due to the massive gathering and storing of user data, there are extra risks related with privacy Macdonald, S. (2026).

6.1 Data Types

Different kinds of data about users may be gathered by academic libraries, including:

- Personal identification data
- Users' search queries and browsing history
- History of borrowed material
- Usage statistics of digital materials

6.2 Privacy Issues

Some of the prominent privacy-related problems are:

- Unauthorized access to personal data
- Data distribution with third parties
- Lack of knowledge among users concerning data collection processes
- Possibility of surveillance due to digital technologies

The majority of users do not realize they are tracked in digital library spaces.

7. Security Challenges in Academic Libraries

Due to increased use of technology, there are abundant security encounters associated with cybersecurity that are experienced by the academic libraries. Measures must to be taken in order to ensure that the information systems used in the library are secured (Farid et al., 2025).

7.1 Types of Security Challenges

The different types of security risks are:

- Being aware of sensitive data in the library
- Accessing the library without authorization
- Being subjected to malware attacks
- Using deception against the library users through phishing

7.2 Implications of Security Challenges

Some of the implications of the security challenges are:

- Misuse of sensitive data
- Financial implication on the institutions
- Damage to the institutions' reputation
- Service disruption

8. Ethical Challenges in Digital Libraries

The transition to digital libraries has introduced several ethical dilemmas:

8.1 Balancing Access and Restrictions

It is essential for libraries to ensure unrestricted access to knowledge, similar time adhering to licensing terms and intellectual property laws. The contradiction is in the balance of openness and law enforcement.

8.2 Utilization of Artificial Intelligence

Recommendation software and virtual assistants powered by artificial intelligence are widely employed in libraries today.

These are beneficial to users, they can create bias and infringe on privacy.

8.3 Ownership and Informed Consent

Issues concerning the ownership of library data and its proper usage remain relevant to librarianship. The matter of informed consent is especially important in the field.

9. Current Practices in Academic Libraries

To combat the aforementioned concerns, some current practices employed by most academic libraries include:

9.1 Privacy Policies

Libraries are formulating well-structured privacy policies which include (Clark Hunt et al., 2023b):

- The type of data collected
- The manner of its usage
- Those who have access to the data

9.2 Data Minimization

Minimizing data collection decreases instances of misuse.

9.3 Secure Authentication Procedures

Secure login procedures such as:

- Multi-level authentication
- Encryption

9.4 Education and Training

Educational programs aimed at training library users on:

- The safe use of the Internet
- Data protection
- Ethics in using data

9.5 Regular Security Audits

Conducting regular security checks.

10. The Role of Librarians in Promoting Good Ethics

Librarians are an essential stakeholder when it comes to ensuring good ethics in the management of academic libraries. The roles played by librarians include (Clark Hunt et al., 2023b):

- Preserving the privacy of users' data
- Promoting information literacy
- Guiding users on the proper use of information
- Upholding the rights of users
- Implementation of policy effectively

Furthermore, librarians need to be aware of technology and other ethical considerations.

11. Future Directions

The future of academic libraries will be influenced by new technological developments and increased attention to data ethics. These strategies will be helpful for promoting good ethical practices (Kalota et al., 2025):

11.1 Implementation of Advanced Security Technology

- Utilizing encryption technologies and secure cloud computing
- Using AI technologies for detecting threats

11.2 Development of Ethical Frameworks

It is necessary for educational institutions to have proper frameworks for:

- Handling of data collection and use
- End-users' consents
- Ensuring transparency and accountability

11.3 Application of 'Privacy by Design' Principles

These principles should be included at the design stage when implementing new library technologies.

11.4 Collaboration and Standardization of Policies

Libraries need to work together with:

- Official bodies
- Academic institutions
- Technology providers

for creating standards of operation.

11.5 Professional Development Training Programs

Training sessions for librarians should include training in:

- Security issues
- Ethics
- Digital literacy

12. Recommendations

In light of the findings, the following recommendations are proposed (Farid et al., 2025):

1. Develop and enforce comprehensive privacy policies.
2. Limit information gathering to essential data.
3. Adopt stringent security measures.
4. Arrange for periodic user sensitization campaigns.
5. Adopt transparent data handling processes.
6. Foster responsible use of information via training.
7. Establish ethics committees within organizations.

13. Conclusion

Academic libraries in knowledge-based society should not be underestimated since they bear further duties aside from only providing access to information. Nowadays, in the world of technologies, the relevance of the concepts such as information ethics, privacy, and information security became more significant. Academic libraries should make a move and solve these issues by creating necessary policy, improving security measures, and raising people's awareness of ethical behavior.

A balance between the development of new technologies and ethical issues that arise due to it is important for keeping academic libraries relevant and functioning in the future.

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DIGITAL LIBRARIES AND INSTITUTIONAL REPOSITORIES TRANSFORMING ACCESS TO KNOWLEDGE IN THE INFORMATION AGE

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Abstract

In the digital age, the quick development of information and communication technologies (ICT) has completely changed how knowledge is produced, arranged, accessed, and shared. Digital libraries and institutional repositories (IRs) have become essential infrastructures that facilitate the effective administration and worldwide accessibility of academic and cultural resources in this changing environment. With an emphasis on their contribution to open access, research visibility, and information diffusion, this paper explores the

conceptual underpinnings, characteristics, and functional functions of digital libraries and institutional repositories.

The study's descriptive and conceptual research design is based on secondary data gathered from books, academic journals, and institutional records. While institutional repositories act as centralized platforms for the preservation and distribution of institutional intellectual output, including research articles, theses, and datasets, it emphasizes the capabilities of digital libraries in offering sophisticated search mechanisms, remote accessibility, and multimedia integration. The complementary interaction between these systems and the larger digital information ecosystem is further investigated in the study.

The results show that these platforms greatly improve academic communication, boost the influence of citations, and aid in the development of institutional reputation. However, obstacles including copyright problems, technical limitations, sustainability issues, and low user awareness still limit their efficacy. The paper also highlights new developments that are anticipated to increase security and efficiency, such as blockchain technology, artificial intelligence, and big data. All things considered, digital libraries and institutional repositories are essential for democratizing knowledge and promoting international research cooperation.

Keywords: Digital Libraries, Institutional Repositories, Open Access, Scholarly Communication, Knowledge Management, Information Systems

1. Introduction

Knowledge creation, storage, and access have all changed as a result of the quick development of information and communication technologies. Once restricted to physical collections, traditional libraries have developed into digital platforms that offer rapid access to a great amount of knowledge. Because they provide structured, long-term access to digital content, digital libraries and institutional repositories are essential to this change.

2. Literature Review

According to Christine L. Borgman's (2000) foundational perspective, digital libraries are not just collections of digital content but rather intricate socio-technical systems. This work highlights the relationship between technology, users, and institutional structures, emphasizing that user-centric design and policy support are just as important to the success of digital libraries as technological infrastructure. The study makes a substantial contribution to our understanding of digital libraries as dynamic spaces that promote international knowledge sharing.

Clifford A. Lynch (2003) expands on the infrastructural aspect by arguing that institutional archives are an essential part of academic communication systems. The examination emphasizes how they help institutions maintain control over their intellectual production while guaranteeing accessibility and long-term preservation. This viewpoint is especially pertinent in light of the growing commercialization of scholarly publishing, as repositories act as substitute avenues for distribution.

Raym Crow (2002), who contends that repositories improve research exposure, citation impact, and institutional reputation, further supports the strategic significance of institutional repositories. The report also emphasizes how they could lessen reliance on conventional publication strategies, which would help the open access movement as a whole. This is in line with the increasing desire in both developed and developing countries for fair access to knowledge.

Jingfeng Xia and Li Sun (2020) offer empirical insights into the efficacy of open access systems, showing that open access repositories greatly boost citation rates and research distribution. According to their findings, research outputs that are openly accessible are more extensively used and acknowledged, which increases academic influence. Additionally, this study indicates that repositories are essential for bridging the information gap between institutions with different resource availability levels.

Stephen Pinfield, Salter, and Bath (2021) analyze the global environment of open access repositories and offer a more comprehensive policy and governance viewpoint. Their study demonstrates how institutional commitment, appropriate policy frameworks, and long-term financing sources are critical to successful implementation. In order to maintain long-term viability, the study emphasizes how crucial it is to match repository strategy with global open access programs.

Eloy Rodrigues, Tammaro, and Pinto (2022) provide a critical analysis of the practical difficulties related to repository adoption. According to their findings, repositories frequently have poor involvement despite the acknowledged advantages because of low awareness among researchers, a lack of incentives, and technological difficulties. This reveals a discrepancy between the goals of policies and their actual execution, highlighting the need for more user-centered tactics.

Thomas Baker (2012) highlights the importance of standardized metadata frameworks, such as the Dublin Core Metadata Standard, in guaranteeing compatibility and effective information retrieval from a technological perspective. For large-scale digital library systems, the study demonstrates how structured metadata improves discoverability and permits smooth integration across digital platforms.

In addition, metadata collection and cross-repository integration have been made possible by the Open Archives Initiative's (2001) development of the OAI-PMH protocol. The development of global knowledge networks has been made easier by this technical breakthrough, which has greatly enhanced access to dispersed digital information.

Norbert Lossau (2019) examines the incorporation of new technologies into digital library systems, emphasizing how AI may improve information retrieval, automated indexing, and customized user experiences. According to the study, by offering more precise and context-aware results, AI-driven systems can overcome some of the drawbacks of conventional search algorithms.

Melanie Swan (2015) presents the potential use of blockchain technology to guarantee the safe, transparent, and impenetrable administration of digital documents. This method is especially useful for dealing with problems pertaining to trust and data integrity in academic communication systems.

The literature identifies enduring issues in spite of these technological developments. Copyright and intellectual property issues are major obstacles to the widespread use of open access repositories, according to Alma Swan (2012). In order to promote content sharing, the study highlights the necessity of precise institutional policies and legal frameworks.

Sheila Corral, Kennan, and Afzal (2013) concentrate on sustainability difficulties, pointing out that inadequate infrastructure, a lack of qualified human resources, and financing constraints are the main obstacles to long-term repository success. According to their findings, capacity building and strategic planning are crucial for preserving repository efficacy.

3. Research Gap

Despite the fact that there is a large body of research on digital libraries and institutional repositories, the majority of these studies focus on specific aspects of these systems, such as technology architecture, open access regulations, metadata standards, or repository administration. A thorough theme synthesis that incorporates organizational, technological, and user-centered aspects into a cohesive framework is lacking. Furthermore, the environment of digital libraries and institutional repositories has not adequately incorporated new advancements like blockchain technology, artificial intelligence, and open scientific projects. Existing literature also provides limited discussion on difficulties relating to sustainability, user participation, institutional preparation, and long-term digital preservation. Therefore, by incorporating current advancements, difficulties, technologies, and future directions in digital libraries and institutional repositories, this study aims to present a critical narrative synthesis of available knowledge.

There are still a lot of unanswered questions about digital libraries and institutional repositories (IRs), especially when it comes to user interaction and real-world application. The majority of the research now in publication concentrates on technological frameworks and system functionalities, paying little attention to user awareness and involvement in developing nations. Low digital literacy, a lack of training, and a lack of institutional attempts to encourage usage impede the efficient use of repositories in many places, including India. Furthermore, repository systems do not incorporate cutting-edge technology like blockchain and artificial intelligence (AI). These technologies are extensively debated in principle, but little is known about how they might be used in practice to improve data security, metadata creation, and search efficiency.

Furthermore, because most studies use conceptual or descriptive methods rather than data-driven research, there is a lack of empirical analysis of institutional adoption techniques. In many institutional contexts, elements including organizational preparedness, financing accessibility, policy support, and technology infrastructure have not been sufficiently investigated. Additionally, there aren't many comparative and region-specific studies that evaluate the efficacy of repositories across disciplines and institutions. In order to improve the efficacy of digital libraries and institutional repositories, this study intends to close these gaps by examining new trends, identifying important obstacles, and highlighting the necessity of combining technological advancements with user-centric and institution-focused strategies.

4. Objectives of the Study

- To explain the conceptual framework and key features of digital libraries, including storage, retrieval, accessibility, and metadata systems.
- To analyze the role and operational functions of institutional repositories (IRs) in preserving and disseminating scholarly output.

- To assess the benefits and challenges of digital libraries and IRs, focusing on accessibility, research visibility, copyright, and sustainability.
- To examine the impact of digital libraries and IRs on open access and scholarly communication in academic environments.
- To explore and propose the integration of emerging technologies for improving efficiency, security, and scalability of digital knowledge systems.

5. Research Methodology

In order to investigate digital libraries and institutional repositories, this study uses a descriptive and conceptual research design. Instead of gathering original data, it focuses on using current information to comprehend their characteristics, functions, advantages, and difficulties. Journal articles, books, papers, and reliable websites are among the secondary data sources that form the basis of the study. It employs a qualitative method for analyzing results and emphasizing new developments in digital knowledge systems, and it employs literature analysis and topic evaluation to locate important patterns and insights.

Research Design

Based on a narrative literature review methodology, the current study uses a qualitative descriptive research design. The study's main goal is to methodically compile and evaluate the corpus of academic research on digital libraries and institutional repositories. This research focuses on the analysis and interpretation of current academic knowledge to develop a thorough understanding of the concepts, functions, advantages, difficulties, and emerging trends associated with digital libraries and institutional repositories, in contrast to empirical studies that rely on primary data collection through surveys, interviews, or experiments.

The researcher can uncover important themes, patterns, theoretical viewpoints, and technological advancements in the field of digital information management by integrating data from many academic sources using the narrative review approach. This method works especially well for conceptual studies that seek to give a general grasp of a field and suggest future lines of inquiry and application.

Data Sources

All of the secondary data included in the study came from reliable academic and institutional sources. Data were collected from globally renowned academic databases and information repositories to guarantee the dependability and thoroughness of the reviewed literature.

The major sources used for literature collection include:

- **Scopus:** One of the largest multidisciplinary databases containing peer-reviewed journal articles, conference proceedings, and scholarly publications.
- **Web of Science:** A leading citation database providing access to high-quality research across various academic disciplines.
- **Google Scholar:** A widely used academic search engine that indexes scholarly literature from journals, books, theses, conference papers, and institutional repositories.
- **Emerald Insight:** A database offering research publications in library science, information management, and related fields.
- **SpringerLink:** A comprehensive platform providing access to academic journals, books, and conference proceedings.
- **Taylor & Francis Online:** A major source of scholarly articles covering information science, digital technologies, and knowledge management.

- **Institutional Reports and Repository Documentation:** Reports published by universities, research institutions, and professional organizations regarding repository implementation and management.

UNESCO Publications: Policy documents and guidelines related to open access, digital preservation, and knowledge dissemination

6. Digital Libraries

6.1 Concept

An organized collection of digital items that can be accessed via electronic systems, such as text, photos, audio, video, and multimedia, is referred to as a digital library. Digital libraries, in contrast to traditional libraries, allow worldwide access to resources and are not constrained by geographical limits.

6.2 Features

1. Digital storage and efficient retrieval of information

Large amounts of data in electronic formats can be safely stored digitally thanks to digital libraries. Through well-organized databases and speedy search methods, they guarantee effective retrieval.

2. Advanced search, indexing, and metadata capabilities

To find information fast and precisely, they offer sophisticated search tools. Organization and content discoverability are improved by indexing and metadata capabilities.

3. Remote access for users across geographical boundaries

Remote access allows users to access resources from any internet-connected location. This facilitates flexible, anytime learning and eliminates geographical boundaries.

4. Simultaneous access for multiple users

Multiple users can access the same material at the same time with digital libraries. This reduces waiting times for information access and enhances teamwork.

5. Integration of multimedia content

Multimedia content, including text, music, video, and photos, can be integrated with them. This improves educational opportunities and accommodates a range of user preferences.

6. Preservation of rare, fragile, and historical materials

Through digitization, digital libraries guarantee the preservation of rare, delicate, and historical resources. By doing this, priceless materials are safeguarded and made broadly available for later use.

7. Institutional Repositories: Definition and Purpose

7.1 Definition

Digital archives maintained by academic or research institutions for the purpose of gathering, preserving, and sharing their intellectual output are known as institutional repositories (IRs). Research articles, theses, dissertations, conference proceedings, and datasets are examples of these outputs.

7.2 Purpose

Providing a coordinated and long-lasting digital environment for the management of academic resources created within an institution is the main goal of institutional repositories. They assist the transmission of knowledge to a worldwide audience, provide greater accessibility to research outputs, and facilitate long-term preservation. IRs also support academic research transparency and institutional knowledge management.

8. Relationship Between Digital Libraries and Institutional Repositories

Although digital content is handled by both systems, digital libraries are more comprehensive and frequently contain a variety of collections from many sources. The work of a single institution, however, is the exclusive focus of institutional repositories. IRs are frequently seen as a subset of digital libraries, though.

9. Benefits

9.1 Benefits for Researchers

By removing time and space barriers and offering quick access to academic resources across disciplines, digital libraries and institutional repositories greatly enhance information access. Because research outputs kept on open-access platforms are more easily found and utilized by the international academic community, they also help to enhance citation and visibility. These platforms also make it possible for researchers to share their discoveries more rapidly, get prompt feedback, and speed up the entire research process.

9.2 Benefits for Institutions

By highlighting the caliber and volume of intellectual output at the national and international levels, these platforms improve the prestige of academic and research organizations. By methodically arranging research resources in a single digital repository, they facilitate centralized knowledge management and improve monitoring and retrieval. Institutional repositories also promote the institution's academic reputation by acting as an intellectual showcase that highlights faculty accomplishments, student research, and cooperative ventures.

9.3 Benefits for Society

From a wider angle, digital libraries and repositories facilitate equal access to knowledge by lowering obstacles associated with cost and location and making research and instructional materials freely available. They facilitate chances for lifelong learning, allowing people from different backgrounds to keep learning new things. Additionally, by digitizing and preserving historical records, manuscripts, and heritage materials, these systems support cultural preservation by guaranteeing their accessibility for upcoming generations.

10. Technologies and Standards

To guarantee effective information organization, accessibility, interoperability, preservation, and long-term

sustainability, digital libraries and institutional repositories rely on a range of technologies and standards. Modern digital knowledge management systems are built on these technologies.

- Metadata standards (Dublin Core, MARC)
- Repository platforms (DSpace, EPrints)
- OAI-PMH protocol
- Cloud Computing and storage and systems

10.1 Metadata Standards

Structured data that identifies, characterizes, and makes it easier to retrieve digital resources is called metadata. In order to guarantee uniformity and compatibility across various digital repositories, metadata standards are essential.

The Dublin Core Metadata Standard, which offers a straightforward and adaptable structure with components including title, creator, subject, description, publisher, date, and format, is one of the most popular metadata standards. Dublin Core makes it easier to find resources and share information in a variety of digital contexts.

Libraries utilize MARC (Machine Readable Cataloging) widely to catalog bibliographic information, making it another significant standard. MARC makes it possible to organize and describe library resources in great detail, improving information management and retrieval accuracy.

The use of standardized metadata greatly enhances resource sharing, discoverability, and system integration for digital libraries.

10.2 Repository Platforms

The technology infrastructure needed to store, manage, preserve, and distribute scholarly content is provided by repository systems.

One of the most popular open-source repository systems is DSpace. Research outputs such as journal articles, theses,

dissertations, conference papers, and databases are supported in their preservation. Metadata management, user authentication, workflow management, and interoperability support are among the services that DSpace provides.

Another well-known open-source repository program that makes self-archiving and open access publishing easier is called EPrints. It provides an easy-to-use interface, numerous customization choices, and effective content management features.

These platforms play a major role in open access programs and institutional knowledge management.

10.3 OAI-PMH Protocol

Repositories can communicate metadata with external systems through the widely used Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH).

By enabling metadata collection from many sources, OAI-PMH promotes interoperability between digital repositories. Search engines, aggregators, and repository networks can gather metadata and offer unified access to dispersed digital collections by using this protocol.

The protocol is essential to improving scholarly content's accessibility, discoverability, and visibility within the international research community.

10.4 Cloud Computing and Storage Systems

Cloud computing has become a game-changing tool for institutional repositories and digital libraries. Scalable, adaptable, and affordable methods for handling massive amounts of digital content are provided by cloud-based storage systems.

Benefits of cloud computing include:

- Reduced infrastructure costs.
- Enhanced storage capacity.
- Remote accessibility.

- Automatic backup and disaster recovery.
- Improved collaboration and resource sharing.

Cloud technologies enable institutions to efficiently manage digital collections while ensuring data security and system reliability.

10.5 Digital Preservation Standards

One of the main goals of digital repositories is long-term preservation. Digital resources are shielded from data loss and technology obsolescence by digital preservation standards and technologies.

Through distributed storage and many copies spread over geographically separated locations, systems like LOCKSS (Lots of Copies Keep Stuff Safe) and CLOCKSS (Controlled LOCKSS) guarantee the preservation of digital content.

Even in the event of hardware loss, system malfunctions, or technological advancements, these preservation techniques provide ongoing access to academic resources.

11. Challenges

- Copyright and intellectual property issues
- Financial Sustainability
- Technical infrastructure limitations
- Lack of awareness and participation
- Long-term digital preservation
- Despite their numerous benefits, digital libraries and institutional repositories face several challenges that affect their implementation, sustainability, and effectiveness.

11.1 Copyright and Intellectual Property Issues

- Scholarly material sharing and distribution are frequently restricted by copyright laws. Open access dissemination is hampered by the embargo periods

and self-archiving rights imposed by many publishers. Institutions must promote knowledge accessibility while carefully navigating licensing and legal restrictions.

11.2 Financial Sustainability

- Constant financial commitment is needed for the creation and upkeep of digital repositories. Particularly for organizations with tight budgets, the costs of physical infrastructure, software updates, cloud services, cybersecurity precautions, and qualified staff can result in substantial financial strains.

11.3 Technical Infrastructure Limitations

- Many educational institutions, especially those in poorer nations, struggle with issues like obsolete hardware, insufficient storage space, poor internet connectivity, and a lack of technological experience. The efficient deployment and administration of repository systems are hampered by these restrictions.

11.4 Lack of Awareness and Participation

- Researchers, academics, and students must actively participate for institutional repositories to be successful. Many potential contributors, however, are either not motivated to deposit their academic works or are yet ignorant of the advantages of repositories. Low participation rates can also be a result of inadequate training and marketing initiatives.

11.5 Long-Term Digital Preservation

- Long-term digital resource preservation is difficult due to the rapid advancements in technology. Software programs, storage medium, and file formats may become outdated, requiring ongoing migration and preservation activities to guarantee accessibility in the future.

11.6 Data Security and Privacy Concerns

- Cybersecurity risks, such as illegal access, hacking, virus assaults, and data breaches, are becoming more prevalent in digital repositories. Strong security regulations, encryption techniques, and frequent system monitoring are necessary to guarantee the availability, confidentiality, and integrity of digital content.
- For digital libraries and institutional repositories to be as successful and long-lasting as possible, several issues must be resolved.

12. Future Trends

The future of digital libraries and institutional repositories is predicted to be profoundly altered by the quick development of digital technologies. New potential for enhancing information management, accessibility, security, and scholarly communication are being created by emerging advancements like artificial intelligence, big data analytics, blockchain technology, cloud computing, and open scientific efforts. The efficiency, scalability, and sustainability of digital information systems will all be improved by these advancements.

- Artificial intelligence for intelligent categorization and search
- Analytics of big data for user insights
- Blockchain technology for safe data administration
- Connectivity to international research platforms
- The expansion of open science programs

12.1 Artificial Intelligence for Intelligent Information Management

- By automating a number of information management procedures, artificial intelligence (AI) is predicted to completely transform how digital libraries and institutional repositories operate. Digital resources can be automatically classified, categorized, and indexed

by AI-powered systems, which minimizes the amount of manual labor needed for content management and metadata development.

- By comprehending user behavior and making tailored recommendations based on past queries and usage patterns, machine learning algorithms can increase search accuracy. By offering semantic search capabilities that comprehend the context and meaning of user queries rather than depending only on keyword matching, Natural Language Processing (NLP) technologies can further improve information retrieval.
- Digital repositories can be made more intelligent and user-friendly by using AI to provide automatic content summarizing, plagiarism detection, metadata production, and predictive analytics.

12.2 Big Data Analytics for Enhanced Decision-Making

Opportunities for the use of big data analytics are presented by the growing amount of digital data produced by institutions and researchers. Large datasets can be analyzed by repository systems to comprehend institutional performance, research trends, resource usage patterns, and user activity.

- Institutions can benefit from big data analytics:
- Keep an eye on access data and repository usage.
- Determine which resources are often accessed and highly cited.
- Evaluate scholarly influence and the impact of research.
- Enhance tactics for collection development.
- Encourage making decisions based on facts.
- Administrators can obtain important insights that help with more efficient repository administration and policy creation by using sophisticated analytical tools.

12.3 Blockchain Technology for Secure and Transparent Knowledge Management

In digital environments, blockchain technology has shown promise in resolving problems with data security, authenticity, ownership, and trust. Blockchain produces a decentralized, impenetrable system in which records cannot be changed without permission.

- Blockchain technology can be utilized in institutional repositories and digital libraries to:
- Check the legitimacy of academic papers.
- Defend the rights to intellectual property.
- Keep open records of the results of your research.
- Encourage safe data exchange between organizations.
- Stop illegal changes from being made to digital assets.

Blockchain technology integration can enhance the integrity of digital knowledge repositories and boost confidence in academic communication platforms.

12.4 Expansion of Open Science and Open Access Initiatives

It is anticipated that the global shift toward Open Science will have a major impact on how institutional repositories and digital libraries develop in the future. Unrestricted access to research articles, datasets, techniques, and instructional materials is encouraged by Open Science.

- Increasingly, institutional repositories will function as platforms for:
- Publication through Open Access.
- Open exchange of research data.
- OER, or open educational resources.
- Research projects including collaboration.
- Public interaction with scientific understanding.

- The worldwide research community will benefit from increased transparency, collaboration, reproducibility, and knowledge democratization as a result of the acceptance of open scientific principles.

12.5 Integration with Global Research Networks

It is anticipated that future repository systems will become more integrated via scholarly communication platforms and worldwide repository networks. Improved interoperability standards will make it easier for repositories all around the world to communicate information.

- Integration with international research infrastructures will offer:
- Increased visibility of the results of institutional research.
- Enhanced scholarly resource discoverability.
- More chances to work together internationally.
- Increased research diffusion and citation effect.
- Greater involvement in international knowledge ecosystems.
- Institutions will be better equipped to contribute to global information sharing and scientific progress because to this connectedness.

12.6 Cloud-Based Repository Ecosystems

Because cloud computing technologies provide scalable, adaptable, and affordable infrastructure solutions, they will continue to revolutionize repository administration. Future repositories will probably use multi-cloud and hybrid designs that facilitate effective disaster recovery, backup, and storage.

- Ecosystems for cloud-based repositories will offer:
- Increased storage capacity.
- Better accessibility across many devices.

- Lower maintenance expenses.
- Automatic software updates.
- Improved data security and catastrophe recovery.
- These features will ensure long-term viability while assisting institutions in more efficiently managing expanding digital collections.

12.7 Mobile and User-Centric Digital Library Services

Mobile-friendly digital library services are being developed as a result of the increased use of smartphones and mobile technology. The improvement of user experience through mobile applications, adaptable interfaces, and customized services will be a major focus of future digital libraries.

- Some examples of user-centric developments are:
- Digital collections are accessible on mobile devices.
- Tailored suggestions for content.
- Voice-activated search features.
- Online reference services.
- Learning environments that are interactive.
- These advancements will increase the accessibility of digital information resources for a variety of user communities in various geographic places.

12.8 Digital Preservation and Sustainable Knowledge Management

Long-term preservation will continue to be a top goal as digital information grows. Advanced technology for automatic preservation, format migration, and risk assessment will be incorporated into future preservation methods.

- It is expected of institutions to implement thorough preservation systems that guarantee:
- Digital resources' long-term accessibility.
- Defense against obsolescence of technology.

- Maintaining academic and cultural heritage.
- Sustainable digital asset management.
- These initiatives will assist the ongoing expansion of digital scholarship and protect important information resources for future generations.

13. Discussion

The study's conclusions demonstrate the increasing importance of digital libraries and institutional repositories (IRs) in supporting the production, preservation, distribution, and accessibility of information in the digital era. Examining the conceptual underpinnings of digital libraries, analyzing the function of institutional repositories, evaluating their advantages and disadvantages, assessing their contribution to scholarly communication, and investigating the potential of emerging technologies in improving digital knowledge systems were the goals of the study. The results of the literature evaluation are in line with the findings of earlier studies and offer strong support for accomplishing these goals.

According to the report, digital libraries have revolutionized traditional information management techniques by making it possible for digital resources to be efficiently stored, retrieved, organized, and distributed. These results align with the work of Borgman (2000), who highlighted that digital libraries are sophisticated socio-technical systems that enable knowledge sharing through technological infrastructure and user-centered services rather than just collections of digital content. The efficiency of information access and use across academic and research communities has been greatly enhanced by the integration of advanced search methods, metadata standards, multimedia resources, and remote accessibility.

The results show that institutional repositories are essential for the preservation and distribution of intellectual outputs, including research datasets, theses, dissertations, journal articles, and conference papers. This conclusion is consistent with

Lynch's (2003) description of institutional repositories as crucial infrastructure for academic communication in the digital age. In a similar vein, Crow (2002) contended that repositories improve institutional visibility and enable wider distribution of research findings. The current analysis supports these claims by showing that repositories promote institutional knowledge management goals while aiding in the long-term protection of intellectual property.

The study also shows that institutional repositories and digital libraries play a major role in advancing scientific communication and open access. The exposure, accessibility, and citation effect of scholarly work are all increased when research outputs are made available through open-access repositories. These results corroborate Xia and Sun's (2020) empirical findings that open-access repositories have a beneficial impact on citation performance and research dissemination. Similarly, Pinfield, Salter, and Bath's (2021) research emphasizes the growing significance of repository-based publishing strategies in fostering fair access to academic knowledge. Digital repositories enable the democratization of knowledge and encourage broad involvement in research activities by lowering barriers related to subscription-based publishing.

The study highlights a number of issues that still have an impact on the successful deployment and long-term viability of digital libraries and institutional repositories, despite their many benefits. Unrestricted access and material exchange are still severely hampered by copyright and intellectual property issues. These results are in accord with Swan's (2012) emphasis on the necessity of precise legal and policy frameworks to enable open-access initiatives. The need for institutions to make ongoing investments in digital preservation systems, software maintenance, technological infrastructure, and qualified human resources has also made financial sustainability a significant concern. According to Corrall, Kennan, and Afzal (2013), repository development and long-term sustainability are frequently hampered by insufficient financing and resource limitations.

The results also show that user participation and awareness continue to be important factors in determining the success of repositories. Despite the fact that many universities have set up repositories, low awareness, insufficient rewards, and insufficient training opportunities often result in low levels of involvement among academics. This observation corroborates the results of Rodrigues, Tammaro, and Pinto (2022), who found that institutional commitment and user participation were important determinants of repository effectiveness. In order to promote active participation among researchers and students, the study emphasizes the significance of awareness programs, capacity-building activities, and supporting institutional policies.

The study makes a significant contribution to how developing technologies will influence digital knowledge systems in the future. According to the literature, technologies like big data analytics, blockchain, cloud computing, and artificial intelligence have a lot of promise to improve the efficiency, security, and functionality of repositories. While blockchain technology can increase data integrity and openness in academic communication, AI-powered solutions can enhance metadata production, content classification, and information retrieval. These results align with the findings of Lossau (2019) and Swan (2015), who emphasized the revolutionary potential of decentralized and intelligent technology in digital information systems.

The paper also highlights the increasing significance of international cooperation and open science programs. Digital libraries and institutional repositories are anticipated to serve as key infrastructures for knowledge exchange across institutional and geographic barriers as research becomes more multidisciplinary and global. Repositories can improve discoverability, boost citation impact, and promote cooperative innovation when integrated into international research networks. These advancements are in line with current global initiatives to advance open science, scientific openness, and fair access to knowledge.

Broader Implications

The study's conclusions have significant ramifications for academic institutions, legislators, researchers, librarians, and information specialists. To optimize repository utilization, academic institutions can improve repository policy, provide sufficient funding for technology infrastructure, and support awareness campaigns. In order to promote open-access publication while safeguarding intellectual property rights, policymakers should create supporting legal and regulatory frameworks. To maintain long-term sustainability, librarians and repository managers should concentrate on improving user involvement, metadata quality, and digital preservation techniques.

From a wider social standpoint, digital libraries and institutional repositories help democratize knowledge by ensuring that everyone has equal access to information, regardless of institutional, financial, or geographic restrictions. They promote lifelong learning, encourage teamwork in research, protect academic and cultural heritage, and help spread scientific knowledge to a variety of groups. These platforms will play a bigger role in promoting sustainable knowledge production and international academic advancement as digital revolution continues to disrupt higher education and research ecosystems.

The results show that institutional repositories and digital libraries are essential parts of contemporary scholarly communication systems. The integration of developing technologies and the growth of open scientific programs offer substantial prospects for improving their efficacy, accessibility, and long-term sustainability, even while issues with funding, technology, copyright, and user participation still exist.

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AWARENESS AND UTILISATION OF E-RESOURCES IN THEOLOGICAL EDUCATION: EVIDENCE FROM THE SYRO-MALABAR SEMINARY LIBRARIES

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Abstract

The rapid advancement of Information and Communication Technologies has transformed the traditional concept of academic libraries from print-based repositories to dynamic digital knowledge centres. In theological education, having access to e-resources is crucial for facilitating teaching, learning, research, and pastoral training. This study examines the level of awareness and utilisation of e-resources among the users of four Syro-Malabar seminary libraries in Kerala. A descriptive research design was used, with data gathered through a structured questionnaire distributed to theological students. 174 valid responses were collected and analyzed with descriptive statistical

methods. The results indicate that most respondents are highly aware of different types of e-resources. The results show that users often use e-resources for academic work, research, and preparing homilies. However, challenges such as a lack of awareness, limited access to e-resources, and inadequate user training affect the effective utilisation of e-resources. The study emphasises the need for improved user-orientation programmes, enhanced digital infrastructure, and collaborative initiatives to strengthen the effective integration of e-resources in seminary libraries and theological education.

Keywords: Electronic Resources, Theological Libraries, Seminary Libraries, Digital Libraries, Syro-Malabar Church

1. Introduction

The rapid growth of Information and Communication Technologies has greatly changed how academic environments acquire, share, and preserve information resources, though it is not the sole influence (Natarajan et al., 2010). A library is not merely a storehouse of books; it serves as an information agency that organises, preserves, and facilitates intellectual access to knowledge resources for information seekers (Lincoln, 2004). Academic libraries, once primarily repositories of printed materials, have transformed into active digital information hubs offering a variety of e-resources such as e-books, e-journals, databases, and other digital materials (Devi & Bhatt, 2024; Konnur, 2019). E-resources have become an integral part in supporting teaching, learning, and research due to their ability to provide convenient, timely, and remote access.

The digital revolution has reshaped the landscape of theological education. Seminaries and theological institutions rely more on scholarly literature in the fields of Bible, systematic theology, philosophy, church history, liturgy, canon law, and pastoral ministry. Traditionally, much of this literature was available only in print, published locally, and often rare and difficult to access over time. Libraries in theological education provide broad exposure to theological traditions and assist candidates

in making sound judgements in ministry (Lincoln, 2004). The growing availability of e-resources related to theology has increased significantly, providing expanded access for students, researchers, and faculty members. The online platforms and e-resources enhance the theological learning experience (Rosario & Muan, 2025; Viktora, 2005). Theological education, equipped with the latest technologies and resources, prepares students to address the challenges of the times (Elkana, 2024). Education and learning no longer take place in isolation. The rapid growth of information resources in digital format and their widespread access greatly enhance the quality of education (Oliver, 2014).

Access to e-resources offers several advantages for theological education, particularly seminary formation. E-resources have become inevitable in theological education, complementing traditional print collections by enabling quick information retrieval, multi-user access, and availability of up-to-date scholarly content (Akuffo & Budu, 2019). Digital platforms allow users to conduct advanced searches across multiple sources, making academic research more efficient and effective. Although these advantages exist, numerous seminary and theological libraries continue to struggle with adopting digital facilities because of limited funding, poor digital infrastructure, inadequate technical support, and a lack of awareness and proper training. Furthermore, the degree of awareness regarding the availability and advantages of these resources among students and faculty members exhibits considerable variability.

In the Syro-Malabar Church, seminaries and their libraries are crucial for the intellectual, spiritual, human, and pastoral development of future priests. (Vaniyapurackal, 2023). As theological education becomes more research-oriented and globally interconnected, access to e-resources becomes ever more important (Holly, 2022). It is essential to know how seminary library users are aware of and use e-resources to enhance library resources and services. In this context, the present study examines

awareness and challenges associated with the use of e-resources in Syro-Malabar seminary libraries.

2. Objectives of the Study

The study's objectives are as follows:

1. To assess how well seminary library users are aware of e-resources.
2. To examine how e-resources are used in theological education.
3. To determine the reasons why library users access e-resources.
4. To examine the challenges encountered in accessing and utilizing e-resources.
5. To propose strategies for enhancing awareness and the effective use of e-resources.

3. Literature Review

The study by Naik and Kumari (2024) discussed the multifaceted impact of e-resources in higher education. The study noted that inadequate technical skills and limited user awareness affected the utilisation of e-resources. The rapid transition from traditional print-based resources to digital formats expanded libraries' role beyond physical spaces, enabling global access to information. Improved digital literacy and effective training programs were essential to overcome the challenges in utilizing e-resources effectively.

Elkana (2024) explored how STT Kerusso Indonesia modernised theological education by integrating digital technology in the training programs to meet the demands of a changing world. The study argued that the traditional approach to instruction and learning was no longer sufficient; therefore, students should develop technological competency and digital literacy. This study emphasised the need to develop technological infrastructure and to adopt a technology-based curriculum.

Bala and Vitthalrao (2024) highlighted the increasing significance of online services in meeting the evolving information requirements of users within academic institutions. These services are essential for providing timely and convenient access to scholarly resources. The study also noted several challenges, such as limited infrastructure, a lack of technical skills, and inadequate internet connectivity, which continued to affect the effective accessibility of e-resources. The accessibility to these resources could be improved by expanding e-document delivery and virtual reference services.

Devi and Bhatt (2024) explored the transition of academic libraries towards e-resources, enabling wider access to scholarly information. Awareness and training considerably influence the effective use of e-resources in the educational process. Access to e-resources significantly increased research productivity in academic institutions, but their effective utilisation depends on factors such as technological infrastructure, user awareness, training, and institutional support.

Akuffo and Budu (2019) investigated the adoption and utilisation of e-resources among postgraduate students at the Akrofi-Christaller Institute in Ghana. While the respondents demonstrated high awareness and recognised the academic benefits of e-resources, the investigation identified significant barriers to access, including poor network connectivity and inadequate user training. The study recommended implementing regular, continuous information literacy programs and establishing remote access systems to improve research-related activities in theological education.

4. Methodology

The study has followed a descriptive survey design to analyse users' awareness and utilisation of e-resources among seminary library users. The study population consists of students from Syro-Malabar seminary libraries. The research took place across four major seminaries of the Syro-Malabar Church in Kerala.

A purposive sampling technique was adopted to choose the seminaries. These include St. Joseph Pontifical Seminary, Aluva (ALW), St. Thomas Apostolic Seminary, Kottayam (KTM), Mary Matha Major Seminary, Thrissur (TSR), and Good Shepherd Major Seminary, Kunnoth (KUH). These seminaries are major centres of theological education within the Syro-Malabar Church and have established libraries. This study has some limitations because it focuses solely on the views of theology students and research scholars, without gathering data from other seminaries and other users.

A structured questionnaire served as the main tool for gathering data. Purposive sampling was utilized to select and distribute questionnaires to library users, including theological students and research scholars who regularly access library facilities. The questions addressed awareness of e-resources, frequency and purpose of use, access points to e-resources, and difficulties encountered in using them. The determined sample size for the questionnaire distribution was 200 respondents (50 questionnaires allocated per seminary). This is to obtain a balanced representation and enable comparison across seminaries, and equal allocation would avoid overrepresentation by larger seminaries and facilitate comparative analysis. Out of these, 174 valid responses were received and used for analysis. The response rate is 87%. The data were analysed with descriptive statistics, such as frequency distributions, percentage analyses, and mean scores, to identify patterns of awareness, usage, and challenges faced by users when accessing e-resources in the Syro-Malabar Seminary libraries.

5. Result and Discussion

This section presents and discusses the results of the study. This section includes the distribution of respondents, awareness of various types of e-resources, frequency of use and preferred access points, purposes for using e-resources, and challenges encountered in accessing them.

5.1 Distribution of Respondents

Table 5.1 Distribution of Respondents

Seminaries	Valid Responses		Category of Respondents		
	Number	Percentage	Th	MTh	RS
ALW	46	26.44%	39 (84.78%)	5 (10.87%)	2 (04.35%)
KTM	44	25.29%	35 (79.55%)	4 (09.09%)	5 (11.36%)
TSR	41	23.56%	41 (100%)	0	0
KUH	43	24.71%	43 (100%)	0	0
Total	174	100%	158 (90.80%)	9 (05.17%)	7 (04.02%)

(Th=Theology, MTh=Master of Theology, RS=Research Scholars)

Table 5.1 presents the distribution of respondents by seminary and category in this study. A total of 174 responses were obtained from four Syro-Malabar major seminaries in Kerala: ALW, KTM, TSR, and KUH. Among the seminaries, ALW contributed the highest number of respondents with 46 (26.44%). KTM had 44 respondents (25.29%), KUH had 43 (24.71%), and TSR had 41 (23.56%). The distribution of respondents is comparatively balanced, thereby guaranteeing sufficient representation from each seminary.

Regarding the category of respondents, the majority belong to the Th programme. 158 (90.80%) respondents come under this category. A smaller proportion of respondents are from the MTh and RS, comprising 9 (05.17%) and 7 (04.02%) respectively. Respondents from all three academic categories were included in the seminary-level category (ALW and KTM). In contrast, respondents from TSR and KUH consisted of Th users. Overall, this table shows that most respondents are theology students. The inclusion of MTh and RS, though small in number, provides additional perspectives on the awareness and utilisation of e-resources in advanced theological studies.

5.2 Awareness of Different Types of E-resources

Table 5.2 Awareness of Different Types of E-resources

No	Type of E-resources	Aware		Not Aware	
		Number	%	Number	%
1	E-Books	152	87.36%	22	12.64%
2	E-Journals	146	83.91%	28	16.09%
3	Online Databases	128	73.56%	46	26.44%
4	Institutional Repositories	96	55.17%	78	44.83%
5	Digital Libraries	134	77.01%	40	22.99%
6	Websites & Online Portals	140	80.46%	34	19.54%
7	Open Access Resources	118	67.82%	56	32.18%

Table 5.2 presents the level of awareness of different types of e-resources among the users of Syro-Malabar seminary libraries. Among the listed resources, e-books had the highest level of awareness, with 152 (87.36%) respondents, while only 22 (12.64%) were not aware of e-books. This is followed by e-journals, for which 146 (83.91%) respondents indicated awareness, whereas 28 (16.09%) did not. The widespread familiarity with e-books and e-journals suggests that users are generally well-versed in digital scholarly literature.

A considerable level of awareness was observed regarding websites and online portals, with 140 (80.46%) respondents, and 134 (77.01%) respondents showed awareness of digital libraries. Awareness of online databases and open-access resources is slightly lower, with 128 (73.56%) and 118 (67.82%) respondents, respectively. The lowest level of awareness is observed for institutional repositories, with only 96 (55.17%) respondents aware and 78 (44.83%) unaware.

The findings demonstrate that a significant number of respondents are familiar with e-resources such as e-books, e-journals, and online databases that support theological research and study. However, awareness of specialised resources, such as institutional repositories and open access, remains comparatively lower. Library orientation programmes and training sessions

could significantly improve the effective utilisation of e-resources in theological education.

5.3 Frequency of Using E-resources

Table 5.3 Frequency of Using E-resources

No	Frequency of Use	Number	ALW	KTM	TSR	KUH	χ^2 value	p-value
1	Daily	68 (39.08%)	16	17	17	18	6.45	0.89
2	Several Times a Week	52 (29.89%)	13	11	15	13		
3	Once in a Week	24 (13.79%)	8	9	3	4		
4	Occasionally	18 (10.34%)	5	5	3	5		
5	Rarely	12 (06.90%)	4	2	3	3		
	Total	174 (100%)	46	44	41	43		

Table 5.3 presents how often respondents utilize e-resources for their academic work. The data reveal that e-resources are widely used among users. Most respondents (68; 39.08%) indicated they use e-resources daily. Among these, the highest number of users was recorded for KUH, followed by KTM, TSR, and ALW, with 18, 17, 17, and 16 users, respectively. This indicates a strong reliance on e-resources for regular academic work. The second-largest group of respondents, 52 (29.89%), stated using e-resources several times a week. In this category, TSR had the highest number of respondents with 15, followed by ALW and KUH, each with 13, and KTM with 11. A small number of respondents, 24 (13.79%), reported using e-resources once a week, while 18 (10.34%) reported using them occasionally. In contrast, only 12 (06.90%) respondents rarely used e-resources.

A Chi-Square test was conducted to examine whether the frequency of using e-resources differs across the four seminaries. The value was 6.45, and the p-value obtained was 0.89. As it exceeds the significance level of 0.05, there is no statistically significant association between seminary and the frequency of e-resource use. The data show similar patterns in e-resource usage. The findings indicate that the majority of seminary library users access e-resources regularly, either daily or several times a week. This suggests that theological students integrate e-resources into their academic activities.

5.4 Most Preferred Access Points for Accessing E-resources

Table 5.4 Most Preferred Access Points for Accessing E-resources

No	Access Points	ALW	KTM	TSR	KUH
1	Library	21 (45.65%)	23 (52.27%)	18 (43.90%)	19 (44.19%)
2	Classroom	8 (17.39%)	5 (11.36%)	6 (14.63%)	5 (11.63%)
3	Personal Room	14 (30.43%)	12 (27.27%)	15 (36.59%)	16 (37.21%)
4	Computer Centre	3 (06.52%)	4 (09.09%)	2 (04.88%)	3 (06.98%)
	Total	46	44	41	43

Table 5.4 presents the most preferred access points used by respondents for accessing e-resources. Although users access e-resources from multiple locations, they are asked to select the most preferred location. The library emerged as the most preferred access point among respondents. The highest number of respondents is from KTM (23, 52.27%). ALW follows with 21 respondents (45.65%), KUH with 19 (44.19%), and TSR with 18 (43.90%). The data indicate that the library serves as the primary access point for e-resources. The personal room is the second-most-preferred location for accessing e-resources. The

highest usage is reported in KUH (16, 37.21%), followed by TSR (15, 36.59%), ALW (14, 30.43%), and KTM (12, 27.27%). This indicates that a majority of respondents favour a private and easily accessible setting for obtaining e-resources.

The classroom is a less-used access point, according to the data. Among the seminaries, ALW (8, 17.39%) recorded the highest number of respondents. It is followed by TSR (6, 14.63%), KUH (5, 11.63%), and KTM (5, 11.36%). Though the classroom is not the primary access point, it is also used during the academic sessions. The computer centre ranked lowest in terms of preference among the access points. Few respondents are using this facility. KTM reported the highest number of respondents (4, 09.09%), followed by ALW (3, 06.52%), KUH (3, 06.98%), and TSR (2, 04.88%). This data shows that library users prefer to use their personal devices for accessing e-resources over the shared devices available in the computer centre. The analysis of Table 5.4 shows that seminary students most frequently access the library and personal rooms. The trend highlights the increasing use of personal devices and a preference for flexible study environments in theological education.

5.5 Purpose of Using E-resources

Table 5.5 Purpose of Using E-resources

No	Purpose	ALW	KTM	TSR	KUH	Total
1	Academic Study	33	31	30	28	122
2	Research/Assignments	31	32	26	27	116
3	Spiritual Reading	23	22	23	25	93
4	Homily Preparations	28	27	25	26	106
5	Personal Knowledge	23	20	19	23	85

Table 5.5 outlines the five main reasons why library users access e-resources for theological education. Since respondents were allowed to select the three most important purposes, the total responses exceeded the number of respondents. The data indicates that the primary reason for using e-resources is academic study, with 122 responses. Among the seminary-wise

analysis, ALW (33) reported the highest number of responses, followed by KTM (31), TSR (30) and KUH (28). The second major purpose is research or assignments, and this section received 116 responses. The highest number of responses was recorded for KTM (32), followed by ALW (31), KUH (27), and TSR (26).

A considerable number of respondents indicated that homily preparation was an important purpose, with 106 responses. The distribution across seminaries shows ALW (28), KTM (27), KUH (26), and TSR (25). This indicates that e-resources have a supportive role in preparing homilies and pastoral reflections. Another significant purpose is spiritual reading, which received 93 responses. Among seminaries, the highest number of responses was reported by KUH (25), followed by ALW (23) and TSR (23) each, while KTM (22) marked substantial usage. This reflects that e-resources are used for personal spiritual formation. The purpose of personal knowledge recorded 85 responses, the fewest but still notable. Overall, this table shows that the e-resources are mainly used for academic research, homily preparation, spiritual reading, and personal growth.

5.6 Challenges faced in Using E-resources

Table 5.6 Challenges Faced in Using E-resources

No	Challenges	ALW	KTM	TSR	KUH	Total	χ^2 value	df	p-value
1	Slow internet Connectivity	13	15	21	27	76	18.14	15	0.255
2	Lack of Awareness	28	22	30	26	106			
3	Lack of User Training	25	22	23	19	89			
4	Technical Issues	23	24	19	17	83			
5	Limited access to E-resources	32	30	15	20	97			
6	Limited Computer Terminals	17	19	15	20	71			

Table 5.6 presents the major challenges seminary users face in utilising e-resources for their theological education. Users were allowed to select three major challenges out of the six listed options. The most frequently reported challenge is a lack of awareness, with a total of 106 responses. At the seminary-wise analysis, TSR (30) reported the highest level of the problem, followed by ALW (28), KUH (26), and KTM (22). This suggests that many library users do not know about the available e-resources or how to access them. The second major issue identified in the table is limited access to e-resources, with 97 responses. This challenge is particularly noticeable in ALW (32) and KTM (30), indicating that access points to e-resources are restricted. The lack of user training is relatively similar across the seminaries, with ALW (25) reporting the highest number, followed by TSR (23), KTM (22), and KUH (19). Proper training sessions or workshops are required to access and utilise e-resources effectively and efficiently.

Another significant challenge is technical issues. A total of 83 respondents reported this issue. The highest number of respondents was recorded in KTM (24) and ALW (23). Slow internet connectivity was noted as a challenge by 76 respondents. Among the seminaries, KUH (27) reported the highest number of responses, followed by TSR (21). There is an urgent need to improve the technical infrastructure. The least reported challenge is limited computer terminals, with 71 responses. The distribution is relatively balanced across the seminaries, though KUH (20) and KTM (19) reported the highest values.

A Pearson's Chi-Square test of independence was performed to determine if the difficulties in using e-resources varied significantly across the four seminaries. The test showed that there was no strong evidence of a connection between the seminary and the reported challenges, as indicated by the results ($\chi^2 = 18.14$, $df = 15$, $p\text{-value} = 0.255$). The distribution of challenges is similar across the four seminaries. There is no statistically significant association between the seminary and the

challenges. Therefore, the pattern of challenges experienced in using e-resources was comparable across the seminaries.

6. Conclusion and Recommendations

This study analyzed users' awareness, usage patterns, reasons for using, and challenges faced with e-resources in Syro-Malabar seminary libraries. The findings suggest that e-resources are now a crucial component of theological education, especially in seminary training. majority of users are aware of the major types of e-resources, and usage patterns show that e-resources are regularly used for academic purposes, research assignments, and homily preparation. Notably, the library continues to serve as the preferred access point for e-resources. Lack of awareness of available e-resources, limited access to them, and lack of proper user training are identified as the most significant issues (Abraham & Sabu, 2022). Overcoming these challenges can improve how libraries utilize e-resources effectively.

The findings carry important implications for the future growth of seminary libraries within theological education. The effective integration of e-resources for supporting theological education has become essential. The positive responses from library users regarding the use of e-resources indicate that libraries are to be transformed from traditional print-based centres into digital knowledge centres (Ravichandran & Abraham, 2026). Integration of e-resources into theological education alone is not enough, but developing new pedagogical competencies with the help of digital technologies is more meaningful (Viktora, 2005). Library orientation programmes, information literacy workshops, and training sessions should be incorporated into the theological curriculum to strengthen digital research skills. Besides, there is an urgent need to improve the technological infrastructure in seminary libraries (Devi & Bhatt, 2024; Samuel Elkana, 2024; Zhao et al., 2026).

Future studies may expand the scope by including other seminaries and theological institutions from different regions

of India. Research on the impact of e-resources on academic performance, research productivity, and pastoral formation of theological students can be investigated. The pedagogical issues arising from e-resources must be properly addressed to enhance the quality of theological education in future. Research on collaborative efforts, such as seminary library consortia and shared subscription systems, may offer practical ways to enhance access to e-resources in seminary libraries.

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AWARENESS AND PERCEPTION OF ARTIFICIAL INTELLIGENCE TOOLS AMONG STUDENTS OF ST. JOHN'S COLLEGE, ANCHAL, KOLLAM, KERALA

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Abstract

The word artificial intelligence can also be called machine intelligence, as we know everything has become more methodical and involuntary and manpower is reduced, in such a manner, that the man-made intellectual has a unique job in all the progression made today. The study investigates the level of Artificial Intelligence Awareness and Perception Among Students of St John's College, Anchal. Questionnaires were distributed to the 50 students and 50 returned. The five-point scale was used. The questions were framed to survey the awareness about AI tools, perception of AI tools, satisfaction with AI tools, efficiency and effectiveness of AI Tools, the role of libraries in the use of AI tools and the influencing factors of Artificial Intelligence. The study showed that the majority of the students have an awareness of Artificial Intelligence and they are interested in using AI tools for their teaching purposes.

Keywords: Artificial Intelligence, AI tools, Chat GPT 3/GPT-4, Online platforms, social media.

1. Introduction

“Artificial Intelligence (AI): Human intelligence exhibited by machines; the science of designing computer systems to perform tasks that require human intelligence, including visual perception, speech recognition and decision-making. “This is a shared definition of AI. Artificial intelligence (AI) is the theory and development of computer systems capable of performing tasks that historically required human intelligence, such as recognizing speech, making decisions, and identifying patterns. AI is an umbrella term that encompasses a range of technologies, including machine learning, deep learning, and natural language processing.

The first steps of artificial intelligence were taken by the scientist Alan Turing. In 1950 Turing published an article titled “Computing Machinery and Intelligence”. In this article, he posed the question “Can machines think?” and rejected the objections in the form of “No, they cannot think” (Pirim, 2006). Turing made studies in this field because he thought machines could handle the abilities such as decision-making and problem-solving which are traits peculiar to humans. As a result of these studies, the Turing test was introduced (Arslan, 2020). After Turing, who was accepted as the ancestor of artificial intelligence, research and applications in this field continued without losing any momentum. In light of these research and applications, it has become possible to assert that beyond establishing intelligent systems, artificial intelligence constitutes the basis of systems that think like humans and develop solutions.

According to AL Kanaan, (2022), the science of artificial intelligence has been advancing at a great pace in recent years. Artificial intelligence, one of the most important technologies of our age, will cause a great transformation for the world. Artificial intelligence has also affected education and training, leading to

significant developments in the field of learning technologies and educational technology. Interest in computer systems and artificial intelligence is increasing and the studies on them are increasing. This article examines the awareness of students on artificial intelligence tools and the issue of digital transformation in education as a result of the development of artificial intelligence, and the new educational processes that will occur as a result of the interaction of humans and intelligent machines.

The transformative potential of AI in higher education is vast, with promising improvements in academic outcomes, learning experiences, and administrative workflows. As AI systems emulate human cognitive functions, they hold the power to generate knowledge independently, aiding tasks such as learning, speech recognition, and complex problem-solving. In the global context, AI is no longer a distant future concept but an integral part of our daily lives. In libraries, AI has the potential to revolutionize essential services provided in the information age.

While AI is making significant strides across various sectors, its application in education, particularly among graduate students, is a critical area of investigation. This project aims to delve into the awareness, perception, and utilization of AI tools among graduate students' future leaders and professionals in diverse fields. Understanding how graduate students currently engage with AI tools in higher education is pivotal for academic decision-makers to develop effective strategies for integrating AI into teaching, learning, and research.

1.1 St. John's College, Anchal, Kollam

St. John's College is one of the Malankara Syrian Catholic Colleges established and administered by the Major Archdiocese of Thiruvananthapuram by the rights of the minority community guaranteed in the constitution of our country. This esteemed center of learning is the fruit of the vision and farsightedness of the late Archbishop Most Rev. Benedict Mar Gregorios. It is currently flourishing under the patronage of His Beatitude Moran Mar Baselios Cardinal Cleemis Catholicos. Ever since its



inception, the College has championed the cause of learning and total development of the region.

While being conscious of its special obligations to provide educational opportunities to the Malankara Syrian Catholic Community, the management of the college extends its service to the members of other communities also. In 2015, the College was re-accredited with an 'A' grade by NAAC after an assessment by its peer team which visited the college from the 26th to the 28th of March, 2015.

The Department of Biotechnology, Ministry of Science and Technology has recognized St. John's College under its Star College Scheme in 2016. It is another golden feather that adorns the crown of St. John's immediately after its NAAC 'A' grade re-accreditation. Ministry of Science and Technology has recognized St. John's College under its DST-FIST program in 2016. It is yet another golden feather that adorns the crown of St. John's immediately after its NAAC 'A' grade re-accreditation and Star College recognition.

St. John's College has a unique identity. It is a lighted lamp set on the mountain to illumine generations with insights, to

eradicate the darkness of ignorance, poverty and evils; and to pave the way to equip the individuals and the society of a remote mountainous area, with the standards of modern life. It is the fulfillment of one of the towering aspirations of the Malankara Major Archi Episcopal Catholic Church. The educational development of the region justifies her existence. Educational service as a process for transformation and integral growth is inspired by a vision of humankind and the rest of the creation and its destiny drawn from the life and teachings of Jesus Christ.

1.2 College Library

The library is situated at the heart of the College. It has an area of 8000 sq. feet. A reading space of 2000 sq. feet is arranged on two floors. It has a spacious circulation counter and a well-furnished reading space. Teak wood cupboards and wood and iron racks are used for keeping books. The carpet area of the Stack Room is 3000 Sq. feet. It is full-fledged, well-furnished and computerized with a digital library.



The library has been upgraded as a first-grade library in 1982. At its initial stage, the library totally depended upon the Management for funds for the procurement of books and other developments. Later the Government began to extend financial support. The library receives UGC grants also.

1.3 The common AI tools used by students

- **Chat GPT-3/GPT-4** It is one of the creations of Open AI, and it is the most popular, sophisticated and free chatbot that is hands down one of the best AI tools. The users can get it to write research papers and use various prompts to get answers to a variety of questions. It can even help to code, and since it's an open-source program, it can be used for multiple purposes, including commercial and personal uses. It is also used to get answers to difficult questions and even ask the chatbot to use a certain type of tone it communicates with users. It is certainly one of the best AI tools for students to use to save time and learn faster using its wide resources.
- **Grammarly:** Grammarly is a text correction, paraphrasing, grammar correction and plagiarism-checking AI tool. It is considered among some of the best AI tools for students since it helps in whacking out grammatical mistakes and helps to provide a better sentence structure. Grammarly has developed its advanced artificial intelligence, which it uses to understand text in a contextual format and help its users write accordingly. It can help students write mistake-free, and in any tone or contextual format they might need.
- **Quill Bot:** is an AI writing tool that empowers users to create captivating and remarkable pieces of writing. It is capable of comprehending text in its context and providing relevant paraphrases for single lines or entire paragraphs. It stands out as one of the finest

AI tools for students, offering not only paraphrasing capabilities but also the ability to summarize long-form content, identify and resolve plagiarism issues, provide grammar checks, and offer language translation.

- **Open AI Playground:** Open AI has been around for a long time and is probably one of the most commercially and widely used tools by students. They can create fresh content using its text-davinci-03-based text module, which creates new copies and research papers from scratch that are mostly plagiarism-free and free to use. Used for content creation.
- **Fotor:** Fotor AI is a tool that can help users come up with amazing pieces of AI-generated artwork, the scope is limitless, and the only limiting factor will be the user's imagination. It uses text prompts to analyze what we want and return an artwork exactly as we requested. The user can use it to get images generated from scratch that can be used anywhere they want, be it the PowerPoint presentation you have to create or an infographic to show people what impacts are needed to head towards sustainability. Fotor can do it all with its advanced art creation AI. It is one of the best tools for students studying to become designers or artists. It helps provide them with fresh perspectives to explore new horizons.
- **Otter.** Otter AI is also one of the best AI tools for students. It makes the lives of students much more laid back, taking the stress of taking notes in every lecture out of them. Otter AI helps students record and transcribe lectures and their voices at the same time, and this allows them to focus solely on reading and studying. The AI tool is so powerful that it captures the sounds and turns them into text at a speed of 160 words per minute. Its impeccable accuracy ensures that you can use it even though you're in a class or attending

a group study with friends. It keeps the user up to date with its ability to take notes at a very fast pace. The best thing about this top AI tool is that it integrates with multiple applications at the same time.

- Google Translate: Uses deep learning models to translate text from one language to another. (Blog, 2023)

2. Review of Literature

There are innumerable studies on awareness of Artificial Intelligence among Students. Among those studies, some of the recent studies are reviewed here.

Michael Negnevitsky (2005) Artificial intelligence is one of the growing subjects within the computing/engineering curriculum area. Despite this, traditional textbooks continue to place demands on mathematical and programming knowledge that are above the capabilities of today's undergraduates and concentrate on topics that are unrelated to many of the courses offered today. Negnevitsky teaches students how to create intelligent systems using methods from evolutionary computation, knowledge-based systems, neural networks, fuzzy systems, and now intelligent agents. Without using complicated mathematics, the underlying concepts of these strategies are presented, along with examples of how to utilize each strategy and when it is appropriate to employ them. The book does not make any assumptions about a specific programming language or bind itself to any specific software tools.

According to the 2018 Horizon research, the experts prognosticate that between 2018 and 2022, the use of AI would increase by 43%. Nowadays, young people, especially students frequently use cell phones or tablets. This gives the students the chance to use AI applications at any time and they are very capable of adapting to new things easily. (Akinwalere & Ivanov, 2022)

Mansor, Hamid, Anwar, Mohd Isa, & Abdullah, (2022) conducted a study that explores the awareness and knowledge of artificial intelligence (AI) among accounting students to spark and cultivate their interest in this evolving field. Drawing on insights from a PricewaterhouseCoopers (PwC) study suggesting a potential 14% increase in global GDP by 2030 due to AI, the researchers focus on understanding the perspectives of accounting students. Findings from the survey reveal that accounting students possess a fundamental understanding of artificial intelligence. However, the majority of respondents agree that AI has a substantial impact and provides benefits in various ways. The study's conclusions contribute new information and insights into how AI technology influences the knowledge and interest of individuals, particularly among accounting students. This research underscores the importance of periodically updating awareness and knowledge of AI, considering its significant role in shaping the future landscape.

Beig & Qasim (2023) Artificial intelligence is currently playing a very important role. Their study aims to ascertain how senior secondary students feel about artificial intelligence (AI), as students are very interested in using technology for many reasons and spend a lot of time on computers and mobile devices. 200 seniors from Prayagraj's senior secondary school make up the study's sample. An artificial intelligence attitude scale that was created specifically for this study was employed. Findings showed that senior secondary students' attitudes toward artificial intelligence differed significantly between males and females, and it also showed that 42% of students spent more than three hours using computers and mobile devices. The study also showed that different students who spent different amounts of time using computers and mobile devices had significantly different attitudes toward AI.

Al-Rawi & Syed, (2023) conducted a study at King Saud University (KSU), Riyadh, Saudi Arabia, aiming to assess the awareness, perceptions, and opinions of artificial intelligence

(AI) among undergraduate pharmacy students. Most students (73.9%) were familiar with AI, and 69.4% believed that AI is a technology that assists healthcare professionals. Despite this positive perception, 57.3% were aware that the widespread application of AI could enhance healthcare practices. Moreover, 75.1% of students agreed that the use of AI in medical practice reduces errors. The mean favourable perception score was 29.8 (SD = 9.63), with a significant correlation observed with nationality, age, and year of study. In conclusion, pharmacy students in Saudi Arabia demonstrated a solid understanding of AI, holding generally favourable opinions about its concepts, applications, and advantages. However, the study highlights the students' acknowledgement of the need for additional instruction and training in the field of AI. Therefore, the early introduction of AI-related material in pharmacy education is deemed essential to prepare students for the widespread application of these technologies in their future professional endeavours.

Chaudhry, Sarwary, & Ghal, (2023) conducted a research and empirical studies in undergraduate degree programs, artificial intelligence-based tools are rapidly revolutionizing the field of higher education. However, their impact on the practices currently employed by higher education institutions (HEIs) for continuous learning improvement remains to be investigated. To improve program quality, teaching effectiveness, and other learning support, higher education institutions (HEIs) must become aware of the implications of artificial intelligence (AI)-based tools on students' learning outcomes. These outcomes are typically measured using an assessment- based approach. This is especially true with the introduction of Chat GPT, a conversational AI tool that uses a deep learning model to generate human-like text responses based on provided input. An empirical study was carried out to evaluate Chat GPT's aptitude for handling a range of assignments from various undergraduate degree program level courses and compare its results with the student or students who received the highest scores. To ascertain whether the Chat GPT- generated assignments could pass the academic integrity

tests, they were also examined using the most well-known tools for plagiarism detection, such as Turnitin, GPTZero, and Copy leaks. The study detailed the Bot's shortcomings and emphasized the consequences of the recently introduced AI-powered Chat GPT in higher education, which necessitates a review of the procedures managers and regulators at HEIs currently employ to keep an eye on students' academic progress and enhance their curricula.

(El Iq Bali, Kumalasani, & Yunilasari, (2022) aim to explore the intricate relationship between student and teacher intelligence in the context of utilizing artificial intelligence (AI) in higher education. Employing a qualitative phenomenological approach, the research focuses on Professional AI (PAI) instructors and students at Nurul Jadid University (UNUJA). The findings highlight the dual impact of applying artificial intelligence in higher education, revealing both positive and negative effects on the dynamics of intelligence and learning, particularly when utilized beyond traditional classroom settings. Positive outcomes are identified in the intelligence interaction between educators and students, encompassing the realms of intelligence quotient (IQ), emotional quotient (EQ), and spiritual quotient (SQ). However, the study notes that the understanding of AI technologies among the participants is relatively narrow. Consequently, the study recommends the incorporation of AI ethics into the curriculum to broaden the comprehension of AI technologies and foster a more informed and responsible use of artificial intelligence in higher education.

Ghotbi, N., Ho, M.T. made a study to evaluate the moral awareness of college students regarding artificial intelligence (AI) systems, we have examined 467 surveys collected from 152 Japanese and 315 non-Japanese students in an international university in Japan. The students were asked to choose the most significant moral problem of AI applications in the future from a list of ten ethical issues and to write an essay about it. The results show that most of the students ($n = 269$, 58%) considered

unemployment to be the major ethical issue related to AI. The second largest group of students ($n = 54$, 12%) was concerned with ethical issues related to emotional AI, including the impact of AI on human behavior and emotion and robots' rights and emotions. The study concludes that the moral awareness of college students regarding AI technologies is quite limited and recommends including the ethics of AI in the curriculum.

3. Objectives of the study

The major objectives of the study are

- To measure the awareness and, perception of students on Artificial Intelligence.
- To assess the use of AI tools by students.
- To explore the efficiency and effectiveness of AI Tools.

4. Research methodology

In the research, a form consisting of two parts was used as a data collection tool. In the first part of the form, information about the demographic variables of the participants (Gender, Age and Subject) could be found. The second part subsumed the "Students' Artificial Intelligence Awareness questionnaire", which was prepared by the researcher in a five-point Likert type. The main aim of the study is to make a general awareness about artificial intelligence to the students. Random sampling method used for this study The study utilized 50 respondents of different departments to comprehend their perspectives on Artificial Intelligence framework Awareness on Artificial Intelligence. The collected data was analyzed using MS Excel with frequency and simple percentage method.

5. Analysis of Data

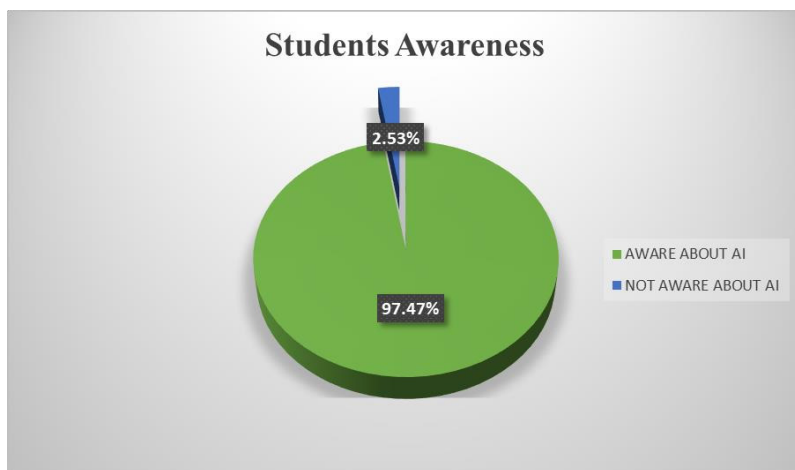
5.1 Profile of the Respondents

Female students (68%) and male students (32%) participated in the study. The age-wise classification shows that 19% of the students are the age of 18 and 21% of students are 19 and others

are in the age of 20. The students from the departments of Environmental Science (7%), Botany and Mathematics (6.12%), Political Science (3.74%) and the students from the department of Hindi and Syriac Language also percolated in this study.

5.2 Students Awareness of Artificial Intelligence.

Artificial intelligence frameworks are utilized in each stroll of our day-by-day life, in short, we can say that our lives have additionally gotten further developed with the utilization of this AI innovation. The applications are operated in various fields like manufacturing units, business entities, medical sciences, Education, in the field of law and technology called driverless vehicles which can sense the environment and broadly utilize the idea of AI. This survey shows that 97.47% of the students are aware of AI and the rest of them have only basic knowledge of the term AI.



5.3 Formal education or training related to Artificial Intelligence

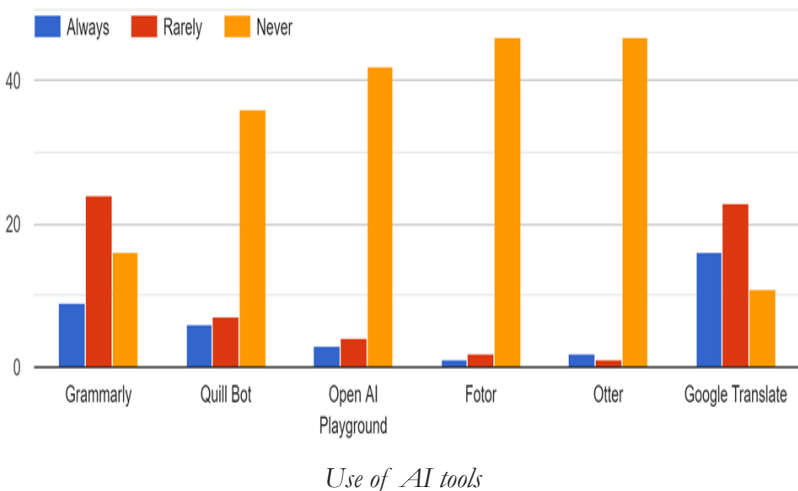
AI is one of the most transformational and fastest-growing technologies of our time. So, training in artificial intelligence tools is required for the present generation. The study result shows that most of the students (92%) did not attend training on Artificial

Intelligence and only a few students (8%) have attended training programs on AI. According to the results of the research, it was concluded that the student's knowledge about the concept of mind and intelligence was insufficient.

5.4 Use of Artificial Intelligence Tools

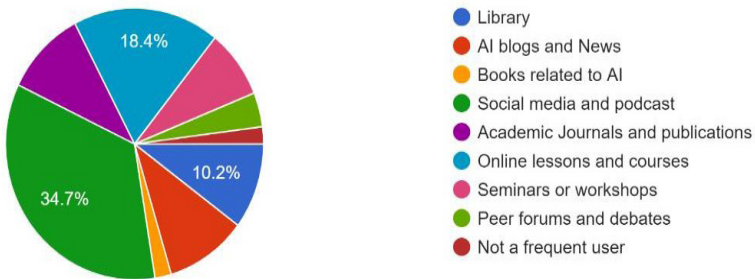
Artificial Intelligence (AI) has been a game-changer in the field of education technology. It has the potential to provide students with personalized learning experiences, help teachers grade assignments faster and more accurately, and offer instant feedback and support to students. Best AI for Schools can help simplify education processes.

The answer to the question on the use of AI tools was very positive (51%) of them are using AI tools and others are not familiar with the Artificial Intelligence tools. The choices included Grammarly, Quill Bot, Open AI, Playground, Fotor, Otter and Google Translate. Following Chart shows that students are always using Google Translator in their academic field. Some of the respondents (10%) prefer to use the Grammarly tool for study purposes. Students who never used Grammarly are very less. The researcher states that students are not familiar with the AI tools named Fotor and Otter



5.5 Sources of up to datedness of AI

In today's fast-paced world, it can be challenging to stay up to date with the latest advancements in tech. In today's world, technology is evolving at an unprecedented pace. Staying informed and up to date with the latest trends and tools is crucial for success. The researcher asked about the resources from where they get alerts for the trends in AI.



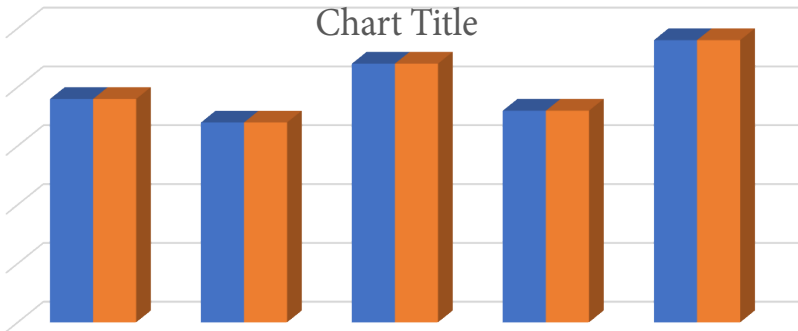
Sources of AI tools

Our students are always using social media. Chart 2 shows that half of the respondents opinioned that they get knowledge on AI from social media and podcasts. Less than 20 per cent of the students (18.4%) use Online lessons and courses to stay up to date in AI. Only (10.2%) of the students say that they are getting knowledge of Artificial Intelligence from the Library.

5.6 Challenges associated with the use of AI tools

Table 5.1 Challenges associated with the use of AI tools

Challenges	Frequency	%
Insufficient training or knowledge on how to use AI tools	19	19%
Limited access to AI-related courses or resources at your institution	17	17%
Premium tools	22	22%
Difficulty in finding appropriate data sites for your research	18	18%
Ethical considerations and concerns	24	24%
others	0	0



From Table 5.1 students have some challenges in using AI tools. Around 22% of college students mention premium tools as a challenge, 18% have difficulty finding appropriate data sites for research, 19% have a lack of training or knowledge about AI tools and their use, 24% have ethical issues in the use of AI tools, and 17% face the limitations of the institution for the access of AI-related tools.

6. Findings

Using 17 questions and answers from the students the researcher found some new ideas. The findings showed that the artificial intelligence awareness levels of the students within the scope of the research were at a good level. The present study reports that 100% of college students (excluding 2.53% of the total because they were not aware of AI tools) are using AI tools at least once for their study purposes. And the study also found that Google Translate is the AI tool that all the students used. According to the results of the research, it was concluded that the student's knowledge about the concept of mind and intelligence was insufficient. From the opinion of students, it is clear that they are using Google Translator and Grammarly for academic purposes. From the opinions of students, it was concluded that the use of technology in education is important. It can be said that there are concerns arising from the findings of the advantages and disadvantages of artificial intelligence, as it is a new technological product. It has emerged that Artificial

intelligence will take away human jobs. As an advantage, it has been concluded that artificial intelligence tools facilitate every field, as well as their use in education will facilitate teaching.

7. Suggestions By Students

1. **Student-Friendly Premium AI Tools:** Ensure AI tools are not only top-notch but also budget-friendly for students, providing access to advanced features without breaking the bank.
2. **Comprehensive Training and Guidance:** Offer thorough training and guidance to students, emphasizing the importance and practical use of AI tools in their academic and research pursuits.
3. **Enhance Accuracy in AI Tools:** Improve the accuracy of AI tools to minimize instances of misinterpreted data, ensuring that students can rely on precise and trustworthy information.
4. **Heighten Security Measures:** Strengthen the security features of AI tools to safeguard students' data and privacy, creating a secure environment for their academic exploration.
5. **Offline Functionality for Flexibility:** Modify AI tools to operate seamlessly without internet access, providing students with the flexibility to use these tools anytime, anywhere.
6. **Multilingual Capability Upgrade:** Upgrade the functionality of AI tools to support the use of more than two languages simultaneously, accommodating the diverse linguistic needs of students and promoting inclusivity.
7. **Holistic Intelligence Integration:** Encourage exploration of free or affordable AI tools that integrate both emotional intelligence (EQ) and intellectual intelligence (IQ) for a holistic experience.

8. New User Support: Develop user-friendly guidelines for new users that are easy to access and understand, supporting a smooth onboarding process.

8. Suggestion by Researcher

Taking into consideration the findings of the study and suggestions received from the users the investigator would like to put forward the following suggestions and recommendations for further development of the users.

- Explore Premium AI Tools for Enhanced Library Services: Consider integrating premium AI tools into the library system to enhance the quality and efficiency of services provided to patrons.
- Ensure the accessibility and affordability of AI tools: Evaluate the accessibility of AI tools by ensuring they are available during all library hours and provide patrons with ample time to utilize these tools for various purposes, including competitive exam preparation.
- Research on Affordable AI Tools: Conduct in-depth research to identify and evaluate affordable AI tools that cater to the specific needs of students, considering functionality, reliability, and cost-effectiveness.
- Training Resources Development: Focus on creating accessible and user-friendly training resources to bridge the gap for students who may lack formal training in using AI tools.
- Security Assessment: Provide proper guidance to avoid security issues and to safeguard user privacy.
- Guidelines for Development for New Users: Develop clear and concise guidelines tailored to new users, facilitating their onboarding process and ensuring effective utilization of AI tools.
- Visual Support Integration: Investigate methods to incorporate visual support, such as images and diagrams,

into AI platforms to enhance user understanding and engagement.

- **Real-Time Information Assessment:** Evaluate the real-time capabilities of free or affordable AI tools, providing insights into their reliability and timeliness in delivering information.
- **Translation Accuracy Improvement:** Research and propose strategies to enhance the accuracy of language translation in AI tools, addressing common challenges and recommending improvements.
- **Safety Rule Enhancement:** Propose enhancements to safety rules and protocols associated with AI tool usage, focusing on affordability without compromising user security.
- **Efficient Information Retrieval Strategies:** Investigate and recommend strategies to optimize information retrieval with free or affordable AI tools, ensuring quick and efficient access to relevant information.

9. Conclusion

This study has explored the revolutionary possibilities of AI tools in the field of education, with an emphasis on their use and effects on graduate students. The use of AI technologies in educational settings presents a previously unheard-of chance to improve academic results overall, expedite administrative procedures, and enhance learning experiences. Institutions must deliberately integrate AI tools as the educational landscape changes to support graduate students in their quest for knowledge and academic success.

The potential uses of AI in education are quite promising going forward. AI tools have the potential to be extremely important in personalized learning, adaptive assessment methods, and the creation of intelligent tutoring systems that are suited to the needs of specific students as long as technology keeps developing. With the knowledge acquired from this study,

graduate students can position themselves as early adopters of new advances and use AI tools to maximize their academic, collaborative, and research pursuits.

AI is already capable of making future predictions. A reliable forecast is necessary for many of our daily decisions, and AI is almost always more accurate at making them than we are. Despite these advancements in technology, humans still don't seem to have much faith in AI predictions Blog, A. (2023, May 8) It is concluded that training and courses are needed for students to get more aware of Artificial Intelligence. Our education field must use AI tools to use in academic purposes. This will make our academic status high. The study concludes that the awareness of college students regarding AI technologies is quite limited and recommends including chapters on AI in the curriculum.

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SUSTAINABLE LIBRARY SERVICES IN THE DIGITAL ERA

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Abstract

In the digital era, sustainability has become an unavoidable factor for institutions across the board. Green buildings and infrastructure gained wide acceptance for sustainable practices in many libraries worldwide. The paper focuses on green library services and operations applicable to academic, public, and special libraries. The study emphasizes a systematic literature review and a global analysis of sustainable practices. The review analyses various sustainable library services adopted in the library world. The role of libraries in sustainable development was noteworthy. Libraries nowadays organize various programs that

highlight the importance of reducing, reusing, and recycling. As a part of these programs, book repair workshops, reuse of materials, and resource sharing are practiced. The concept of a “library of things” has attracted significant attention. The library’s major contributions to the knowledge community were through various services. Thus, waste management and responsible resource consumption become quite easy. Climatic changes and other environmental challenges were among the forces that dragged development in this period. Even though digital transformation was rapid, libraries need to evolve to meet user needs while safeguarding the environment. The paper also addresses the major challenges libraries face when adopting various sustainable services.

Keywords: Eco-friendly technologies, Environment, Green library, Library services, Sustainable services

1. Introduction

Climate change is a serious global threat which increases libraries’ vulnerability. Encountering the realities of climate change has proved difficult for libraries as impacts have escalated. In such situations, adopting appropriate strategic measures is the only way to cope. In all areas, the organization should reflect sustainability. Libraries are more than a center for knowledge preservation; they go beyond multiple roles that contribute to society. The role of the library in sustainable environmental development is noteworthy. Green and sustainable development is not only an energy-saving concept; it also actively integrates with ecological knowledge hubs, fostering eco-friendly community engagement and eco-friendly digital practices. Green libraries adopted energy-efficient infrastructure, such as solar panels, natural lighting, and eco-friendly buildings. Libraries are also adopting energy-efficient servers and green data practices.

Sustainability in library services, at its core, involves various dimensions to achieve the goal. Environmental sustainability includes waste management, eco-friendly resource use, and the conservation of all types of resources. Digital sustainability includes eco-friendly technologies and energy-efficient

equipment, as well as the wise use of digital resources. Social sustainability includes inclusivity, collaboration, and community engagement. Libraries can raise community awareness of these sustainable practices and their implementation. Cost-effective practices and resource management are a major part of these services.

2. Literature review

Bhaghyashri et al. (2026) examined the role of green libraries in Sustainable Development Goal (SDG) 12. The authors suggest that green libraries promote sustainable resource management. The libraries provide community awareness that harnesses to change human behavior towards the ecosystem. The descriptive exploratory study suggested that barriers to sustainability in libraries were complex. The absence of a formal policy framework is considered a serious challenge.

Soni and Singh (2026) examined the elements of a green library building by analyzing Indian and International LIS theses. The study points out that the concepts of sustainability and green have gained wide acceptance, even though they are not widely practiced or implemented. The authors also recommend policy-based models and empirical research on the concept.

Saini et al. (2025) emphasized that libraries can contribute to a sustainable, healthy planet through various initiatives. Libraries were important centers for a sustainable future. The authors analyzed that green libraries were necessary for a resilient and thriving society.

Kedar and Kedar (2024) studied the best practices that contribute to sustainability in libraries. The authors explored practical strategies and innovative solutions to existing challenges. The paper discussed the need for thoughtful planning, collaboration with various institutions, and wider societal contributions.

Ahammad et al. (2024) analyzed published research on library service sustainability using open-source software (OSS).

The authors also examined the factors that contributed to the sustainability of open- source library automation and digitization software. The study addressed various factors, such as financial support, staff training, administrative support, and community support, which have a major role in the sustainability of library services.

Manna and De Sarkar (2022) examined sustainable development practices implemented in selected libraries worldwide. The authors conducted a web-based content analysis study to explore the various initiatives implemented in libraries. The paper also discussed the major challenges libraries face when adopting green strategic measures.

3. Sustainable Library Services

Sustainability has become a major agenda for every institution due to unpredictable climate change and its associated environmental impacts. To gain the ecological balance, many institutions are going green and adopting sustainable measures. The go green strategy not only conserves the ecosystem, but also improves human wellbeing and builds a healthy planet. Libraries, as knowledge and community hubs, are now at the forefront of sustainable initiatives by adopting services and providing facilities that support an eco-friendly society (Soni & Singh, 2026). Libraries offer tools, equipment, documents, and other information resources and services to users, helping them easily locate, access, and retrieve the information they need more effectively and efficiently. In these services, libraries can reduce production costs, minimize duplication, and save energy. To provide sustainable services to libraries, the following are the major initiatives adopted worldwide.

3.1 Resource circulation services

Sharing documents across various libraries and other institutions reduces the need for physical resources, thereby saving money and effort. The technique also promotes digital access, where users can retrieve the information they need anytime, anywhere. The dependency on expensive subscriptions

to databases, journals, and other scholarly content can be minimized. Hence, existing collections can be effectively used, and further studies of existing knowledge can continue wisely. One important benefit of this service is its ability to reduce the carbon footprint. Shared resources can reduce the physical storage, transportation and collections. Book repair and reuse stations and Community donation and redistribution systems are effective measures for extending these services beyond traditional library operations. In the era of Artificial Intelligence (AI), implementing these services is much easier and more effective. AI-powered discovery systems, linked data technologies, GIS facilities, and other knowledge resources can deliver much better services. The system can facilitate better collaboration among institutions, interoperability among libraries, the location of nearest resources, and the provision of relevant and precise information (Oyetola & Oladokun, 2023).

The Library of Things is a sustainable initiative in which libraries offer non-library resources, such as tools, musical instruments, sports equipment, educational materials, game boards, telescopes, and printing kits. Individuals do not need to purchase items they do not use regularly; libraries provide them for temporary use. Thus, it promotes sustainable resource utilization and energy consumption. The Toronto Public Library offers these services to the public with definite loan periods and renewable options. Some items borrowed from the library can be returned to any Toronto Public Library branch, while some items must be returned to the branch from which they were borrowed. The main items offered by the library for lending include book club sets, musical instruments, tech kits (including AI learning kits, Audio Recording and Raspberry Pi Kits), Toronto Reference Library picture collections, and carbon dioxide monitors (Toronto Public Library, 2026).

3.2 Sustainable learning hubs

Libraries can act as sustainable learning hubs offering a wide variety of training, awareness programs, and workshops.

Libraries can contribute to e-learning platforms and digital archives and also serve as a safe space for marginalized groups.

The New York Public Library offers coding classes as part of its summer program. As part of the community engagement, Apple provides assistance with app development and offers a library of the necessary hardware and professional support to achieve these goals. The participating students are provided with all the physical and digital materials required for the course. Once they complete the course, they must return these items so that the upcoming batches can use them (The New York Public Library, 2021).

3.3 Research support services

Libraries offer a wide range of research support services to students, researchers and faculty in order to ensure the accountability, relevance, inclusiveness and ethics of the research work. The role of libraries in providing proper instructions to support research activities is noteworthy. The materials provided by the libraries help carry out research activities without any hurdles. In the era of AI, libraries blend their services to meet users' needs (Bachalapur et al., 2026).

3.4 Green Computing Practices

In the context of green computing practices, libraries wisely use resources without waste or environmental damage. Eco-friendly technologies and sustainable strategies in green computing practices significantly contribute to sustainable development. Some of the green computing practices include using energy-efficient electronic equipment, Virtual computing technologies, cloud-based services, adopting green data centers with efficient renewable energy systems and sources, efficient e-waste management, recycling of electronic gadgets, using eco-friendly digital equipment and employing best energy management practices like using sleeping mode, turn off unused devices (Muthusamy & Palanisamy, 2025).

3.5 Eco-Friendly Digital Literacy Services

The use of more digital equipment increases carbon emissions, thereby harming the environment. Addressing these issues and promoting eco-friendly practices can improve the situation. Providing awareness and educating users on the wise use of digital devices can reduce e-waste and increase equipment lifespan. Libraries assist users in reducing their carbon footprint by helping them reduce carbon dioxide emissions from various online activities, such as playing online games and retrieving information. A disciplined use of digital equipment and resources is one of the best practices, which includes regularly clearing out unwanted emails, uninstalling unused apps, deleting irrelevant e-documents and files, removing duplicate data, and clearing obsolete information sources from devices. Instead of sending large files, it is better to opt for links.

3.6 Disaster management services

Libraries can offer a range of disaster management services to communities to support them during crises. The services assist in preparing for, mitigating, and building resilience against disasters. Information services offered through these services make people aware of the various phases of disaster management. The training programs, evacuation plans, risk mitigation strategies, and safety measures were notable services provided by libraries. Libraries also disseminate important alerts, advisories, and updates during emergencies, which is more helpful in areas with limited digital access. During emergencies, libraries act as rehabilitation centers providing emergency services to the affected people. After the crisis period, libraries can collaborate with policymakers to ensure access to evidence-based information.

4. Challenges

4.1 Financial constraints

Limited financial resources are a major challenge for the adoption of many of these services in libraries. Implementing

sustainable infrastructure requires a high initial cost, even though it yields long-term cost-effectiveness. Many libraries with financial constraints show reluctant to the sustainable development.

4.2 Lack of awareness

Librarians and library professionals lack adequate knowledge in these fields, resulting in limited adoption and integration of techniques and sustainable practices in libraries.

4.3 Lack of Training

Training in the field is highly in demand. Even though services are adopted in libraries, only highly professional or trained staff can provide quality services. They must be trained to use various techniques and must be adaptable to rapid changes.

4.4 Technological Limitations

Libraries face challenges due to rapid system upgrades, which require high costs and extensive resource management in the initial phases. Lack of trained staff, inadequate technical equipment, outdated electronics, and poor network connectivity were major issues.

4.5 Resistance to organizational change

Some libraries found these services unnecessary and were reluctant to adopt them. They perceive the developments as a hindrance to the library's routine activities, especially since the results of these services sometimes need a long time to be evident.

4.6 Environmental impact

Certain environmental issues cannot be avoided to a certain extent. Sometimes, over-reliance on electronic equipment can lead to e-waste and increased energy consumption.

4.7 Regular maintenance

Solar panels, green roofs, and energy-efficient servers require regular inspection and maintenance. This should be expensive and demand labor.

5. Conclusion

Libraries provide multifaceted services in the digital era, offer long-term learning facilities, bridge the digital divide, serve as community engagement hubs, and collaborate with external agencies to enhance services. Libraries are more adaptable and inclusive institutions. Libraries offer empowerment and opportunity to the future generation. Hence, each phase of the development libraries demands the best implementation and adoption. Additionally, sustainability is necessary for society and the environment. The innovative, sustainable library services can contribute to society and communities. The rapid transformation needs administrative support, trained professionals, technological adaptations, and, most importantly, financial support and stability. Effective policy frameworks, strong administrative support, standard budget allocations, adequate training, frequent equipment and server installations, and collaborations with external agencies can contribute to better outcomes. Conducting programs and workshops regarding the sustainable development make users and staffs more aware of the concept and practices. Sustainable library practices uphold environmental protection, technical developments and community engagement.

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USER PURPOSES AND INFORMATION-SEEKING BEHAVIORS IN WEB-BASED MEDIA: A USER-CENTERED APPROACH TO INFORMATION DESIGN ON WEBSITES

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Abstract

The rapid growth of web-based media has fundamentally altered how individuals seek out, obtain, evaluate, and utilize information.

Understanding user objectives and information-seeking habits is essential to creating websites that effectively meet user requests. This study looks at the connection between user goals, information-seeking habits, and website information design. A user-centered approach was used to collect data from 500 participants, including professionals, researchers, students, and everyday internet users. The findings demonstrate that users engage in different information-seeking behaviors based on their objectives, which include academic learning, decision-making, amusement, social connection, and problem-solving. The study identifies key factors influencing website usability, navigation, content layout, and information accessibility. The results support the development of user-centered information architecture models that raise website effectiveness and user happiness.

Keywords: Information-Seeking Behavior, User-Centered Design, Web-Based Media, Information Architecture, Website Usability, User Experience

1. Introduction

The Internet is becoming the primary source of information for millions of individuals worldwide. Websites are essential tools for communication, business, education, research, and amusement. As the quantity of digital content increases, it becomes increasingly important to understand how consumers search for and interact with information.

Information-seeking behavior (ISB) refers to the steps people take to locate, find, access, evaluate, and use information. Modern website design must take into account the diverse objectives and behaviors of users in order to provide meaningful and efficient information access.

A user-centered approach focuses on designing information systems with users' needs, preferences, and behaviors in mind rather than only considering technology. This study looks into how users interact with online content and how effective information design might be influenced by these interactions.

2. Review of Literature

Wilson, T. D. (1981) proposed one of the first comprehensive models of information behavior, emphasizing that users' information-seeking activities stem from their cognitive, social, and environmental demands. His idea is still crucial to understanding how people recognize knowledge gaps and seek out tools to close them. User research and data requirements, T. D. Wilson (1981). *Journal of Documentation*, 37(1), 3–15. <https://doi.org/10.1108/eb026702>

Ellis, D. (1989) identified six common activities involved in information seeking—starting, chaining, browsing, differentiating, monitoring, and extracting. His behavioral model shifted attention from system-centered approaches to user-centered information retrieval processes.

Ellis (1989) distinguished six typical information-seeking activities: initiating, chaining, browsing, discriminating, monitoring, and extracting. His behavioral paradigm moved the focus from system-centered methods to information retrieval procedures that are user-centered. D. Ellis (1989). Information retrieval system design using a behavioral approach. *Journal of Documentation*, 45(3), 171-212. <https://doi.org/10.1108/eb026843>

Kuhlthau, C.C. (1991) presented the Information Search Process (ISP) model, illustrating the emotional, cognitive, and physical aspects of information seeking. The model emphasized users' initial sentiments of uncertainty during the search process and their growing confidence as they acquire more information. C. C. Kuhlthau (1991). Information seeking from the viewpoint of the user within the search procedure. *American Society for Information Science Journal*, 42(5), 361-371. [https://doi.org/10.1002/\(SICI\)1097-4571\(199106\)42:5<361::AID-ASI6>3.0.CO;2-#](https://doi.org/10.1002/(SICI)1097-4571(199106)42:5<361::AID-ASI6>3.0.CO;2-#)

By analyzing user interactions with electronic information systems,

Marchionini, G. (1995) expanded information-seeking research into digital contexts. In online contexts, his methodology focused on navigation, browsing, query formulation, and iterative searching behaviors. G. Marchionini (1995). *searching for information in electronic settings*. Press of Cambridge University.

Choo, Detlor, and Turnbull (2000) looked into how people use the Internet to find information, especially in organizational settings. According to their research, depending on the difficulty of the activity and the information required, web users blend directed searching and browsing techniques. Detlor, B., Choo, C. W., and Turnbull, D. (2000). *Web work: Using the World Wide Web to find information and gain expertise*. Kluwer Academic Publishers, Dordrecht, Netherlands.

Website design was greatly impacted by the information architecture concepts developed by Morville and Rosenfeld (2006). In order to facilitate efficient information retrieval, their work emphasized the significance of content organization, labeling systems, navigation structures, and search methods. Rosenfeld, L., and Morville, P. (2006). *World Wide Web information architecture* (3rd ed.). O'Reilly Publishing.

Garrett, J.J. (2011) created the Elements of User Experience framework, which included usability principles, information architecture, interaction design, and user demands. His approach is now a fundamental component of user-centered website and digital information system design. J. J. Garrett (2011). *The components of the user experience are: Web and beyond user-centered design* (2nd ed.). Fresh Riders.

3. Statement of the Problem

Despite technological developments, many websites fail to adapt to consumers' information-seeking habits. Poor navigation architecture, information overload, and inadequate material layout often make it difficult for users to accomplish their objectives.

This study addresses the need for user-centered information design that considers a range of user goals and information-seeking strategies.

4. Objectives of the Study

1. To identify the primary motivations behind people's use of online media.
2. To examine how individuals use websites to obtain information.
3. To investigate factors affecting the retrieval of online information.
4. To gauge user satisfaction with the current website's information design.
5. To recommend a user-centered information architecture framework for websites.

5. Research Questions

1. What are the main uses of online media?
2. How do people look for information on websites?
3. What aspects of website design facilitate effective information retrieval?
4. What elements affect user satisfaction?

6. Hypotheses

H1: Information-seeking behavior is strongly influenced by user purpose.

H2: Information retrieval efficiency is positively impacted by website usability.

H3: User pleasure is increased via user-centered information design.

7. Research Methodology

Design of Research

research design for descriptive surveys.

Population

Users of web-based media including:

- Undergraduate students
- Postgraduate students
- Faculty members
- Researchers
- Professionals

Sample Size

Using stratified random sampling, 500 respondents were chosen.

Table 1: Distribution of Respondents

Category	Sample
UG Students	200
PG Students	120
Faculty	60
Researchers	50
Professionals	70
Total	500

Data Collection Tools

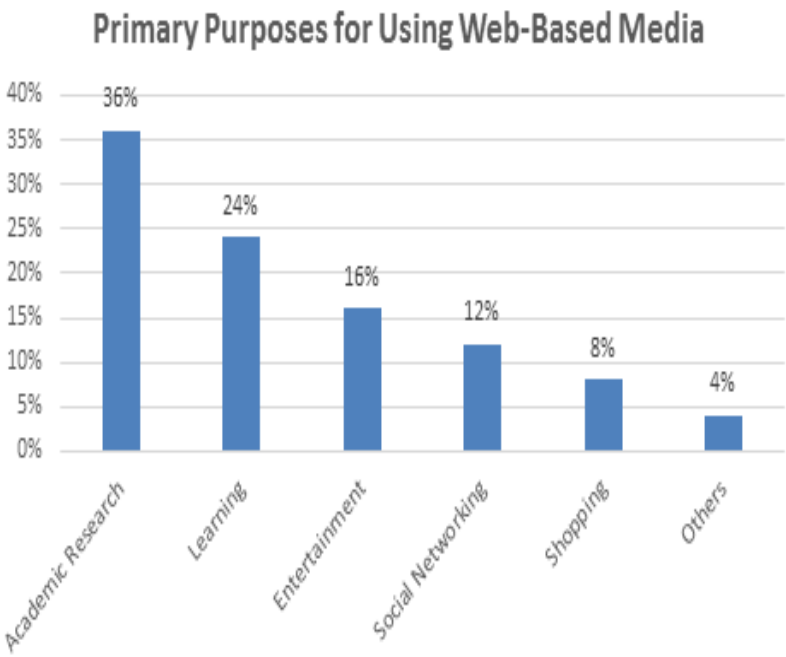
- Structured questionnaire
- Online survey
- User observation
- Website usability testing
- Statistical Techniques
- Percentage analysis
- Mean and Standard Deviation
- Chi-square Test
- ANOVA
- Correlation Analysis

8. Results and Analysis

User Purposes for Accessing Websites

Table 2: Primary Purpose of Website Use

Purpose	Frequency	Percentage
Academic Research	180	36%
Learning	120	24%
Entertainment	80	16%
Social Networking	60	12%
Shopping	40	8%
Others	20	4%



User Purpose Distribution

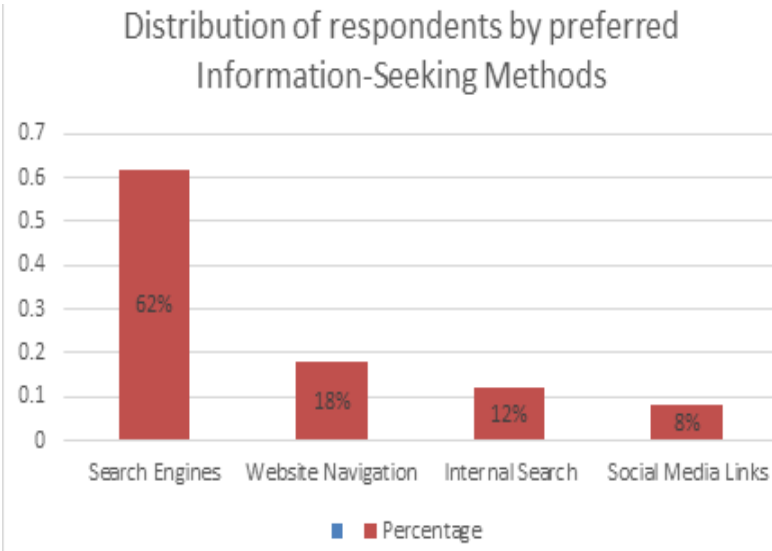
Interpretation

Academic research emerged as the dominant purpose (36%), followed by learning activities (24%).

Information-Seeking Strategies

Table 3: Information-Seeking Methods

Method	Respondents	Percentage
Search Engines	310	62%
Website Navigation	90	18%
Internal Search	60	12%
Social Media Links	40	8%

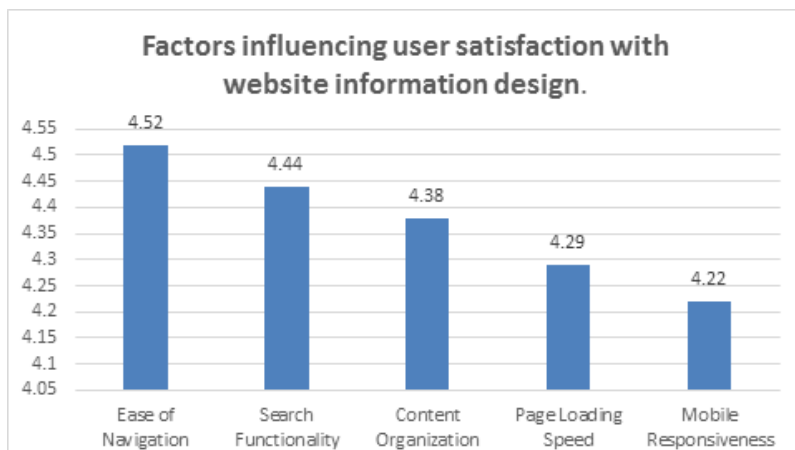


Interpretation

Search engines remain the preferred method for locating information.

Table 4 - Website Design Factors Influencing Information Access

Factor	Mean Score
Ease of Navigation	4.52
Search Functionality	4.44
Content Organization	4.38
Page Loading Speed	4.29
Mobile Responsiveness	4.22

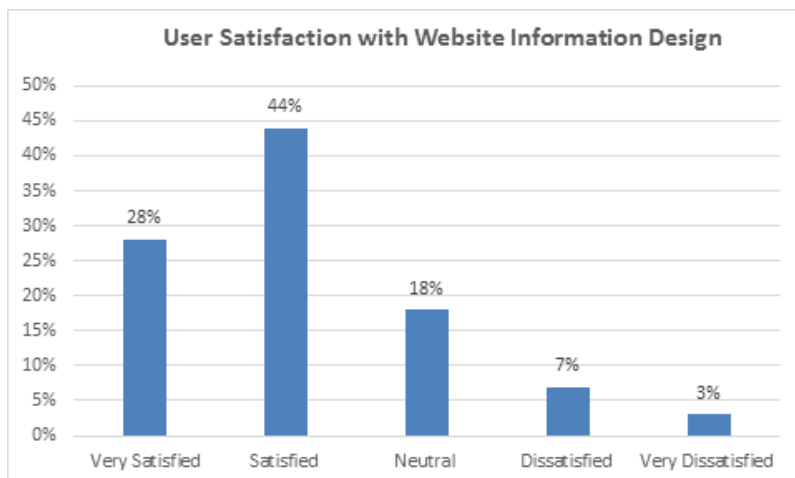


User Satisfaction Levels

Table 5

Satisfaction Level	Frequency
Very Satisfied	140
Satisfied	220
Neutral	90
Dissatisfied	35
Very Dissatisfied	15

Satisfaction Percentage



9. Hypothesis Testing

H1: User Purpose vs Information-Seeking Behavior

Chi-Square Test

Value	Result
χ^2	26.42
p-value	0.001

Decision: Significant relationship exists.

H2: Website Usability vs Information Retrieval

Correlation Analysis

Variable	r-value
Usability and Retrieval Efficiency	0.78

Interpretation: Strong positive relationship.

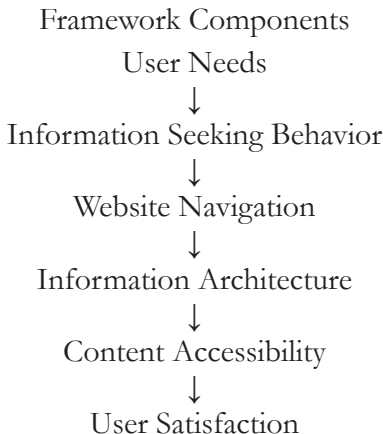
H3: User-Centered Design vs Satisfaction

ANOVA Results

F-value	p-value
8.91	0.000

Decision: Significant impact.

10. Proposed User-Centered Information Design Framework



Key Elements

1. Menus that are simple to use
2. Efficient search techniques
3. Design that adapts
4. Customized recommendations
5. Accessible content architectures
6. Including user input

11. Key Findings

1. The main reason people utilize websites is for academic study.
2. The most popular method for finding information is using search engines.
3. User happiness is strongly impacted by navigation quality.
4. The success of information retrieval is significantly influenced by the usability of the website.
5. The whole user experience is enhanced by user-centered information design.

12. Recommendations

For Website Designers

- Install navigation systems that are easy to use
- Reduce the amount of information overload.
- Improve search powers.
- Enhance mobile responsiveness.
- Apply accessibility standards.

For Educational Websites

- Organize content according to user tasks.
- Provide advanced search options.
- Use personalized learning recommendations.

For Organizations

- Test usability on a regular basis.
- Use analytics to examine user activity.
- Update information architecture on a regular basis.

13. Conclusion

The study shows that effective website information design requires an awareness of user goals and information-seeking behaviors. Designers can produce websites that are in line with users' cognitive processes, information needs, and search tactics by using a user-centered approach. The results show that user happiness and information retrieval efficiency are greatly impacted by usability, navigation, and content structure. User-centered information architecture should be given top priority in future website development to improve accessibility, user experience, and engagement.

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REIMAGINING ACADEMIC LIBRARIES: A CONCEPTUAL FRAMEWORK FOR DIGITAL TRANSFORMATION AND SERVICE INNOVATION

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Abstract

The transformation of the digital arena has created its multiplier effect in building academic libraries into more intelligent, adaptive and user-centric knowledge ecosystems. This study represents a diversified evaluation of this digital evolution spearheaded in the academic libraries, especially on the implemented technologies, used functionalities and systemic limitations. The paper further focuses on the impact of the integration of novel technologies like Artificial Intelligence (AI), cloud computing, big data analytics, and the Internet of Things (IoT)

into the library environments. In addition, a conceptual multi-layered framework encompassing infrastructure, technology, service, and user engagement dimensions is proposed. The data output analysis reflects upon the efficiency brought out by the digital transformation in terms of accessibility, operational efficiency, and research visibility. At the same time reiterates the critical challenges like digital inequality, data privacy issues, financial constraints, and workforce skill gaps. Finally, this study proposes strategic recommendations for more inclusive and sustainable changes in the academic library ecosystem.

Keywords: Digital Transformation, Academic Libraries, Artificial Intelligence, Smart Libraries, Big Data, Cloud Computing, Library Innovation

1. Introduction

Academic libraries have been the cornerstone in fulfilling the functionalities of teaching, learning and research activities as a facilitator and guide. Traditionally, academic libraries were regarded as the epitome for accessing the knowledge systems, but their role has evolved into more diversified arenas with advancements in ICT-related technologies. These technological breakthroughs have created a radical shift in the methods of how information is generated, accessed and used within the academic domain. Hence, digital transformation cannot be confined to automation of repeated tasks or as a process of digitisation of data. Digitization focus on the transformation of physical materials into digitised formats, while automation tries to bring in efficiency within the existing processes or procedures. Hence, digital transformation accompanies a major shift in the working of academic libraries. The existing delivery services would undergo redesign along with more personalised engagement with users and, more importantly, the incorporation of major technologies into the core functionalities would be the major shift.

Several factors contribute to this evolutionary shift. The rising digital resources, the rapid surge of data-driven research domains, and the increased expectation of users for

more streamlined services have all influenced this change of discourse in library management. Hence, libraries are viewed not just as physical spaces for knowledge dissemination but as more dynamic and technology-enabled environments. Hence, more sophisticated tools using artificial intelligence, cloud-based systems, and data analytics are used for a better user experience and to support the research fraternity with efficient delivery of services. In addition, libraries expand to the roles of academic institutions in certain spheres. In providing digital scholarships, managing research data and functions like open access initiatives. These shifts are not free from challenges. Issues expand to infrastructure, funding gaps, privacy issues, ethical dilemmas and staff skill capacity. These limitations slow down the successful implementation of digital technologies. This research study dives into the key technologies and related frameworks supporting the digital transformation in academic libraries along with the challenges. Different perspectives are outlined and discussed for a comprehensive understanding of how libraries evolve, adapt and function with changes in the digital arena.

2. Literature Review

Academic libraries are undergoing a fundamental transformation driven by rapid technological advancements, changing user expectations, and the increasing demand for digital access to scholarly resources. Digital transformation extends beyond automation and digitization; it represents a strategic shift in organizational culture, service delivery, and knowledge management practices.

Kempf (2023) suggests that libraries are changing from traditional models toward knowledge-centred institutions that promote research and learning activities. Recent research found that digital transformation requires technical expertise and technological infrastructure. Nakaziba and Ngulube (2024) demonstrated that continuous professional development, digital competencies, and organizational readiness are important factors that affect the transformation initiatives in academic libraries.

Also, the technical expertise of staff plays an important role in the implementation of digital services. Service innovation is a relevant strategy adopted in libraries nowadays. It changes the concept of libraries from book repositories to active knowledge hubs. Yeh and Walter (2016) observed service innovation in the context of libraries and found that academic libraries must promote a learning-oriented culture, innovation-oriented leadership, and develop a fostering culture to enhance services within libraries. Their research demonstrated that innovation should be integrated within libraries and maintain a collaborative partnership with others to promote research services. Similarly, Islam, Agarwal, and Ikeda (2015) proposed a value co-creation framework in which users actively participate in designing and improving library services. The authors argue that modern academic libraries should transition from service providers to collaborative knowledge partners. This participatory approach enhances service responsiveness and promotes continuous innovation aligned with user needs.

Knowledge management in libraries helps to utilize intangible resources in an effective way. It is used as a catalyst to maximize users satisfaction. Islam et al. (2017) Their findings suggest that knowledge management practices enhance user services in libraries. These practices identify evolving user requirements over time and provide services accordingly to maximize the user satisfaction level. They developed a framework called Knowledge Management for Service Innovation in Libraries (KMSIL), and it represents that the effective creation and sharing of knowledge, will significantly leads to innovative service development. Abdou et al. (2024), found the relationship between knowledge sharing and service innovation in academic libraries. Their study found that information technology innovation and management innovation paved the way for knowledge sharing on service innovation. They found that technological innovations alone will make no impact, but integrating technological innovations with organizational and managerial transformation will enhance knowledge sharing services in libraries.

The increasing integration of artificial intelligence (AI), machine learning, and intelligent systems is further reshaping library services. Subchan (2024) proposed an AI-based conceptual framework for innovative library services, highlighting the potential of AI-driven recommendation systems, virtual assistants, predictive analytics, and personalized information services. The framework positions AI as a key enabler of digital transformation and enhanced user experiences. Digital transformation also requires systematic evaluation of service effectiveness. Ajith et al. (2023) developed a conceptual framework for assessing modern academic library services and identified critical dimensions including accessibility, service quality, user satisfaction, resource availability, and technological support. Their work emphasizes that transformation initiatives should be evaluated through measurable service outcomes and stakeholder perspectives. Looking toward the future, emerging technologies such as artificial intelligence, blockchain, robotics, and metaverse environments are expected to redefine library operations and user engagement. Oyedokun (2025) argues that these technologies will facilitate intelligent resource management, immersive learning environments, and enhanced digital experiences, leading to a new generation of academic libraries capable of supporting research and learning in highly interconnected digital ecosystems.

Collectively, the literature demonstrates that digital transformation and service innovation are interdependent processes. While previous studies have explored technological adoption, knowledge management, service innovation, and AI applications separately, limited research has integrated these dimensions into a comprehensive conceptual framework. Therefore, the present study proposes a unified framework that connects digital infrastructure, organizational capabilities, emerging technologies, and innovative service practices to support the future development of academic libraries.

Objectives of the Study

The objectives of the study are:

- To understand the scope of digital transformation and identify the technological factors contributing to digital transformation in academic libraries.
- To propose a conceptual framework for digital transformation in academic libraries.
- To analyse the key issues, challenges, and barriers in the implementation phase of digital transformation and suggest recommendations for sustainable implementation.

3. Methodology

This study employed a qualitative research approach based on a systematic review of the existing literature. The objective was to examine the current state of digital transformation in academic libraries and to identify the key technologies, challenges, and service innovations that are shaping modern library environments. To collect relevant literature, a systematic search was conducted using 3 major academic databases: Scopus, Web of Science and Google Scholar. These databases were selected because they provide extensive coverage of research in library and information science, higher education, and digital technologies.

The literature search was carried out using combinations of keywords related to digital transformation and academic libraries. Search terms included “digital transformation,” “digitalization,” “technological innovation,” “academic libraries,” “service innovation,” and “service transformation.” Boolean operators such as AND and OR were used to combine keywords and retrieve relevant publications. The selection of studies followed predefined inclusion criteria. Only publications directly related to digital transformation in academic libraries were considered. Peer-reviewed journal articles, conference papers, and reputable

institutional reports were included, while studies lacking sufficient relevance or scholarly credibility were excluded. After the literature was collected, the selected studies were carefully reviewed and analyzed. Key information related to technology adoption, digital services, infrastructure development, user engagement, and implementation challenges was extracted from each study. The findings from the reviewed studies were synthesised to develop a conceptual framework that explains how digital transformation is influencing academic libraries. The framework integrates technological, organizational, and service-related dimensions and provides insights into the evolving role of academic libraries within contemporary higher education environments.

4. Technological Enablers of Digital Transformation in Academic Libraries

Digital transformation in academic libraries is shaped by the integration of advanced technologies that not only modernize infrastructure but also redefine how knowledge is created, accessed, and shared. These technologies support the transition from traditional, collection-centred models to dynamic, user-focused ecosystems. They enable automation of routine tasks, improve efficiency, ensure scalability, and promote interoperability between systems.

4.1 Artificial Intelligence as a Catalyst for Intelligent Library Systems

Artificial Intelligence (AI) plays a crucial role in making library systems smarter and more responsive. It supports automated cataloguing, metadata tagging, and classification. AI-driven chatbots and virtual assistants provide 24/7 reference services, answering user queries instantly. Machine learning algorithms analyze user behavior to deliver personalized recommendations, improving user satisfaction. Natural Language Processing (NLP) enhances search by understanding context and intent rather than just keywords. AI tools also assist in summarizing research articles, extracting key information,

detecting plagiarism, and even supporting academic writing and research workflows.

4.2 Cloud Computing and Scalable Digital Infrastructure

Cloud computing offers a flexible and scalable backbone for modern library systems. It allows libraries to store vast amounts of digital content without heavy investment in physical infrastructure. Users can access resources anytime and from anywhere, which is especially important for remote learning. Cloud-based Library Management Systems (LMS) and SaaS platforms ensure regular updates, reduced maintenance costs, and high system reliability. Also, cloud environments enable integration with databases, e-journal platforms, and institutional repositories, encouraging collaboration and resource sharing across institutions.

4.3 Big Data Analytics and Evidence-Based Decision Making

Big data analytics helps libraries make more informed and strategic decisions. By analyzing large datasets from user interactions, search queries, and borrowing patterns, libraries can better understand user needs. This insight supports smarter collection development, efficient budget allocation, and improved service design. Predictive analytics can anticipate future demands, helping libraries stay proactive. Visualization tools help administrators to track performance, identify gaps, and improve overall efficiency.

4.4 Internet of Things and Smart Library Environments

The Internet of Things (IoT) enables the development of smart libraries where physical and digital systems work together. RFID technology simplifies book tracking, circulation, and stock verification. Smart shelves and sensors reduce the chances of misplaced items and improve inventory accuracy. Environmental sensors help maintain optimal temperature and humidity for

preserving collections. IoT also provides data on how library spaces are used, helping in better space management, seating arrangements, and energy efficiency.

4.5 Digital Repositories and Open Access Ecosystems

Digital repositories are essential for preserving and sharing institutional knowledge. They store theses, dissertations, research papers, and other scholarly outputs in a structured manner. Open access initiatives remove barriers to information, allowing wider dissemination of knowledge and increasing research visibility and citations. These systems support global academic collaboration and knowledge exchange. Additionally, digital preservation techniques ensure that content remains accessible and usable over time, maintaining authenticity and integrity.

4.6 Blockchain Technology for Secure Information Management

Blockchain technology introduces a new level of security and trust in digital library systems. Its decentralized and tamper-proof nature ensures safe management of digital records and intellectual property. It can be used to verify academic credentials, track authorship, and authenticate research outputs. Blockchain also helps manage licensing agreements and secure data sharing between institutions.

4.7 Augmented and Virtual Reality in Immersive Learning Environments

Augmented Reality (AR) and Virtual Reality (VR) are transforming libraries into interactive learning spaces. AR can enhance physical library navigation by overlaying digital information onto real-world environments. VR creates immersive experiences where users can explore virtual libraries, conduct simulations, or visualize complex concepts. These technologies are particularly useful in disciplines that require experiential learning. By integrating AR and VR, libraries expand their role beyond information providers to active learning facilitators.

4.8 Cybersecurity and Digital Preservation Technologies

As libraries increasingly depend on digital systems, ensuring security and long-term access becomes critical. Cybersecurity measures such as encryption, authentication protocols, firewalls, and intrusion detection systems protect sensitive data and prevent unauthorized access. At the same time, digital preservation techniques like format migration, emulation, and backup storage safeguard digital resources from technological obsolescence and data loss. Together, these approaches ensure that digital library systems remain secure, reliable, and sustainable over time.

5. Conceptual Framework for Digital Transformation in Academic Libraries

This framework explains how academic libraries can move beyond basic digitization toward a more meaningful and sustainable form of digital transformation. Instead of treating technology as the sole driver, it presents transformation as a balanced interaction between infrastructure, innovation, services, and user experience. The framework ultimately aims to help libraries build knowledge ecosystems that are not only technologically advanced but also inclusive, accessible, and aligned with academic goals.

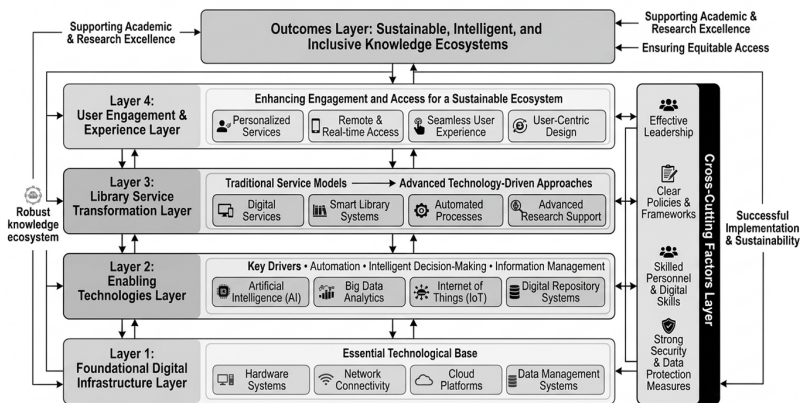


Figure 1. Conceptual Framework for Digital Transformation in Academic Libraries

The digital transformation of academic libraries can be understood as a set of interconnected layers that together shape how libraries evolve in the digital age. At the base is the foundational digital infrastructure layer, which includes hardware, networks, cloud systems, and data management tools. This layer provides the stability and scalability needed to support growing digital demands. Built on this is the enabling technologies layer, where tools like artificial intelligence, big data analytics, the Internet of Things, and digital repositories drive innovation by improving efficiency, automation, and decision-making. The library service transformation layer reflects how these technologies reshape traditional services into more streamlined, integrated, and user-focused models, shifting libraries from collection-centred to service-oriented environments. Closely connected is the user engagement and experience layer, which emphasizes easy access, personalization, and seamless interaction through intuitive and remote-friendly systems.

Across all these layers, the cross-cutting factors layer, including leadership, policy support, skilled staff, and data security, plays a critical role in guiding and sustaining transformation efforts. Together, these layers lead to the outcomes layer, where libraries emerge as more intelligent, inclusive, and sustainable knowledge ecosystems, better equipped to support modern teaching, learning, and research.

6. Challenges and Barriers to Digital Transformation in Academic Libraries

Digital transformation in academic libraries is a complex, multi-dimensional process shaped by technological, organizational, and user-related factors. While the integration of advanced technologies offers significant opportunities, it also introduces a range of challenges that can hinder effective implementation.

6.1 Infrastructure-Level Constraints

At the foundational level, inadequate digital infrastructure remains a major barrier, particularly in resource-constrained

institutions. Limited access to high-speed internet, outdated hardware systems, and insufficient storage capacity restrict the deployment of advanced digital solutions. In many cases, the lack of reliable and scalable cloud infrastructure further complicates the transition toward fully digital environments.

6.2 Technological Integration and Interoperability Issues

The integration of emerging technologies such as Artificial Intelligence, big data analytics, and IoT presents significant technical challenges. Many library systems operate on legacy platforms that are not easily compatible with modern technologies, leading to interoperability issues. The absence of standardized protocols and frameworks complicates system integration.

6.3 Workforce Skills and Capacity Gaps

A critical challenge in digital transformation is the shortage of skilled professionals capable of managing advanced technologies. Librarians are increasingly required to possess competencies in data analytics, digital curation, AI tools, and information systems management. However, many institutions face gaps in training and professional development opportunities. This skills deficit limits the effective utilization of digital technologies and reduces the overall impact of transformation initiatives.

6.4 User-Centric Challenges and Digital Divide

Although digital transformation aims to enhance user experience, it also raises concerns related to accessibility and inclusivity. Not all users possess the necessary digital literacy skills to effectively utilize advanced library systems. Furthermore, disparities in access to digital devices and internet connectivity contribute to a widening digital divide. These issues can prevent user groups from fully benefiting from digital library services.

6.5 Governance, Policy, and Data Security Concerns

Governance and policy-related issues cut across all layers of the transformation framework. The adoption of digital

technologies introduces significant concerns related to data privacy, security, and ethical use of information. The absence of clear policies and strategic guidelines can lead to inconsistencies in implementation and increased vulnerability to security risks. Additionally, ethical challenges such as algorithmic bias and transparency in AI systems require careful consideration.

6.6 Financial and Sustainability Constraints

Digital transformation often requires substantial financial investment in infrastructure, technologies, and human resources. Budget limitations can restrict the ability of libraries to adopt advanced systems or sustain long-term initiatives. The ongoing costs of system maintenance, software licensing, and staff training further add to the financial burden.

7. Strategic Recommendations for Sustainable, Inclusive, and Effective Implementation

This section outlines practical recommendations to support the successful implementation of digital transformation in academic libraries, with a clear focus on sustainability, inclusivity, and long-term effectiveness. A key starting point is the need for strong institutional alignment, where digital initiatives are closely connected to the broader mission and strategic priorities of the institution. Without this alignment, even well-funded technological efforts fail to deliver meaningful impact. Sustainability can be strengthened by investing in scalable and interoperable infrastructure that can grow alongside user demands.

At the same time, continuous professional development is essential, as staff need to be equipped with the skills required to manage and adapt to evolving technologies. Rather than relying solely on external expertise, libraries should build internal capacity through regular training and knowledge-sharing practices. Financial sustainability should also be considered, with careful planning to ensure that new systems can be maintained and upgraded over time without placing excessive strain on

resources. Libraries need to ensure that digital services are accessible to users from diverse backgrounds, including those with limited digital skills or restricted access to technology. This can be achieved by designing user-friendly interfaces, offering digital literacy programs, and maintaining alternative access points where necessary. To enhance effectiveness, libraries should adopt a data-informed approach to decision-making. Regular assessment of service usage, user satisfaction, and system performance can provide valuable insights for improvement. Feedback mechanisms should be simple and ongoing, allowing libraries to quickly identify gaps and respond accordingly. Collaboration is another important factor, as partnerships with other institutions, technology providers, and research communities can open up new opportunities for innovation and resource sharing. Overall, these recommendations highlight that successful digital transformation is not just about adopting new technologies, but about creating a balanced and thoughtful approach that integrates people, processes, and systems. By focusing on sustainability, inclusivity, and continuous evaluation, academic libraries can ensure that their transformation efforts remain relevant, resilient, and beneficial to all users over time.

8. Conclusion

Digital transformation continues its journey with more sophistication for easy delivery of services. This technological revolution spearheads the transformation of academic libraries from traditional to more dynamic, technology-driven ecosystems. This study outlines a comprehensive understanding of this major shift by focusing on the key drivers, challenges and the associated implications. The findings of the study indicate artificial intelligence, cloud computing, big data analytics, and the Internet of Things as core system enablers for this modernization. Their incorporation has improved research efficiency, improved accessibility and better user engagement.

The study also points out that this technological shift is more complex and involves practical challenges like limited accessibility

of high-value data, skill gaps, privacy issues and the digital divide, particularly in rural areas. These concerns reflect the fact that this technological lead cannot succeed with mere adoption; rather should involve organisational readiness and strategic alignment. The multi-layered framework proposed offers a comprehensive perspective by linking infrastructure, technologies, services, and user engagement. In essence, academic libraries are at a crucial juncture where a coordinated effort is essential for their success and making the system more resilient.

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INFORMATION LITERACY (IL) AMONG FACULTY MEMBERS OF THE COLLEGES IN THE KOTTAYAM DISTRICT: AN ANALYTICAL STUDY

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Abstract

The study examines the knowledge of information literacy (IL) among members of faculty across various academic disciplines at various Arts

and Science Colleges in Kottayam district. The aim of the study is to assess the understanding of IL and its use in the teaching - learning process. It analyzes the use of information resources and explores how information literacy is incorporated into the teaching - learning process along with identifying the barriers in accessing and using resources. The study also aims at determining the need for further training to identify and use higher resources. The findings highlight that though most members of the faculty know about information literacy, they face notable challenges like time constraints, limited access, and inadequate training which limit the assimilation of IL to their academic transactions. Faculty with higher academic qualifications and those who use library resources reported greater confidence on their knowledge about IL. The findings underscore the need for institutional scaffolding including training sessions, resource availability and need based interventions. The study contributes to the existing body of knowledge by identifying the major gaps and developing insights that update policy recommendations. The study also aims at strengthening information literacy in higher education institutions.

Keywords: Information literacy, Resource accessibility, Institutional support, Plagiarism, Training needs.

1. Introduction

Today's academic environment, the role of information literacy is becoming increasingly vital for members of the faculty as they are responsible for the dissemination of knowledge and developing critical thinking. The American Library Association (2000) has defined Information literacy as "the ability to recognize when information is needed and to locate, evaluate and use effectively the needed information." It is an essential competency highly recommended for faculty navigating the complexities of both digital and traditional information sources, which they use in their academic transactions. Despite of its growing importance, there is also a growing concern that as they face challenges in fully mastering these skills.

Existing research records have identified significant gaps in the competency of information literacy among faculty. It has also

revealed the presence of divide between the perceived and the actual competencies (Kurbanoglu, 2000; Hepworth and Walton, 2013). Many of these studies are of limited scope, often focused on specific disciplines, geographical areas, or institutional types. This often hinders a comprehensive understanding of the real challenges that the faculty face across various academic scenarios. Additionally, methodologies like self-reported surveys and small-scale interviews are not fully capturing the dynamics and the evolving nature of information literacy in today's scenario.

The aim of this study is to address the existing limitations by conducting a broad survey about the use of information literacy devices among college faculty across various disciplines, assessing multiple dimensions like their information seeking behavior, source evaluation, and the ethical use of information through a structured questionnaire. By surveying of the faculty across multiple disciplines; it is envisioned that an in depth insight into the current status of IL can be sought along with an understanding of the major influencing factors, like access to professional development, instructional support and the integration of IL to the teaching learning process by the users. The analysis also aims at filling the gaps of earlier studies, and provides a better perspective on the use and development of IL as an academic skill. The process also seeks to contribute to the ongoing discourse on the importance of IL in college level academic transactions.

2. Objectives

1. To assess the level of awareness and to understand the knowledge about the various concepts regarding information literacy among members of the faculty at college level across various disciplines in Kottayam district.
2. To evaluate the frequency and methods by which the members of the faculty across disciplines seek and use information resources for teaching and research purposes at college level in Kottayam district.

3. To identify members of the faculty across disciplines at college level in Kottayam district who integrate information literacy components into their teaching practice.
4. To identify the challenges faced by the members of the faculty across disciplines at college level in Kottayam district accessing and utilizing information resources effectively.

3. Literature Review

IL has become an important resource in higher education, especially with the rapid expansion of digital information resources. Members of the faculty across disciplines are the primary facilitators of learning who need to sharpen their information for every academic interaction. Thus a critical role in embedding IL skills into the curricula is necessary as this in turn makes the process of learning easy in convergence with the current techniques of IT. The literature review analyses various existing research on IL as reviewed in similar studies on incorporating IL in the teaching – learning process addressing the possibilities and challenges involved. The review identifies the major themes and gaps in literature and provides the possibilities for advanced research.

3.1 IL: Faculty perceptions and Understanding

There are multiple understandings of IL among various members of the faculty across disciplines in college level. Most of them consider it as research skills/library usage. The gap between understanding and application is the most noted in studies related to IL. On broader terms it is considered as the capability to evaluate and synthesize information (Bury, 2016). He further reports that members of the faculty associate IL with their ability to evaluate information. The difference of perception changes in the integration of IL in the curricula and the cognitive skills emphasized in IL frameworks.

Rafique's (2014) study on the University of Lahore highlights that the members of the faculty recognized the

importance of IL. They often lacked the practical skills to implement it effectively to the teaching - learning process. Asha and Kumari (2019) found that the members of the science faculty in colleges of Karnataka relied on basic research techniques as IL in the academic process. This shows the need for an advanced IL training.

3.2 IL: Challenges in Integration to the Curricula

IL integration into the teaching - learning process poses multiple challenges. Constraints of time, different levels of competency, and constraints in institutional support are some of the major issues. Chilonga (2022) stressed the authoritative role of the members of the faculty has a great role in shaping learners' IL skills. But many members of the faculty do not view themselves as directly responsible for teaching IL. On the contrary they place the responsibility of using IL on to the college libraries. This reliance on librarians results in developing inconsistencies in how IL is addressed across disciplines (Meulemans & Carr, 2012). Moreover, members of the faculty often struggle to see the relevance of IL beyond their specific disciplines, which hampers its integration across the Curricula (Pinto, 2016).

Rafique (2014) has identified a lack of proficiency in basic IL skills among the members of faculty, particularly in using an online public access catalogue (OPAC) and advanced search strategies. This lack of competence significantly impacts faculty member's ability to conduct research and guide learners effectively.

3.3 IL: Impact of Training on Faculty

Training programmes in IL can improve the skills of the members of the faculty to teach and utilize IL skills successfully. Hammons (2020) had highlighted that the development of online IL training programmes for faculty at Ohio State University had improved the participants' understanding and ability to integrate IL into their teaching learning process. Rafique (2014) emphasized the need for tailored IL training programmes at the

University of Lahore to address members of the faculty' specific needs.

However, despite of the recognition of IL's importance, such training programmes are often underutilized (Hammons. 2020). Jayshankar and Alagarsamy (2018) have also noted that women members of the faculty at Mother Teresa Women's University, Kodaikanal were confident about their IL skills but were still requiring continuous training, particularly in digital resource use.

3.4 IL: Role of Faculty in Promoting to the Learners' Skills

Members of the faculty play a pivotal role in fostering IL skills among learners. However the literature regarding the same reveals inconsistencies on how the role is executed successfully. While some members of the faculty actively integrate IL into their curricula, others rely heavily on libraries to take the lead (Chilonga, 2022). An effective connection between the members of the faculty and the members of the library are essential for developing and delivering consistent and comprehensive IL instructions for multiple disciplines (Meulemans and Carr, 2012).

Rafique (2014) describes that the members of the faculty who were proficient in IL had better learner outcomes, particularly in research projects and academic performance. This demonstrates the importance of equipping the faculty with the necessary IL skills to enhance their teaching effectiveness.

4. Methodology

A survey using a detailed questionnaire was used to examine the knowledge of IL among members of faculty across disciplines at college level in Kottayam district. A structured questionnaire was distributed to members of the faculty through Google Forms, yielding 107 responses from members of the faculty across various disciplines. The responses were analyzed using Microsoft Excel. Percentage calculations were used as the main statistical device for interpreting the findings.

5. Analysis

5.1 IL: Awareness of Concepts

Figure 1 shows that 58.5% respondents rated their level of knowledge of IL concepts as “moderate.” 26.4% of respondents consider their level of knowledge of IL concepts as “high,” while 7.5% rated level of knowledge of IL concepts as “low” and 2.8% rated level of knowledge of IL concepts as “very low”. 4.7% of respondents reported their level of knowledge of IL concepts as “very high.” While most of the members of faculties across disciplines have a fair knowledge of IL, there is still need for improving concepts related to the same.

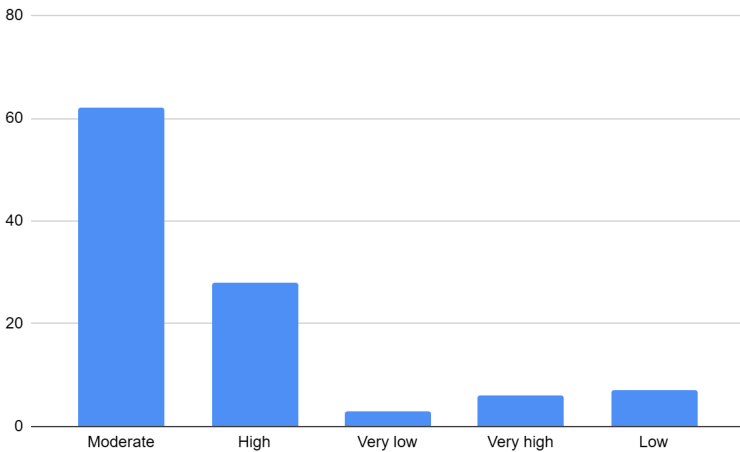


Fig.1: Awareness in IL Concepts

5.2 IL: Participation in Training and Workshops

Figure 2 reveals that the 69.2% of respondents have never attended any kind of training or workshops on IL, while 30.8% have participated in some sort of training. This indicates that a significant portion of members of faculty across discipline in college level lack formal training in IL. The low participation rate highlights the need for more accessible and effective training opportunities to enhance educator’s skills in this area.

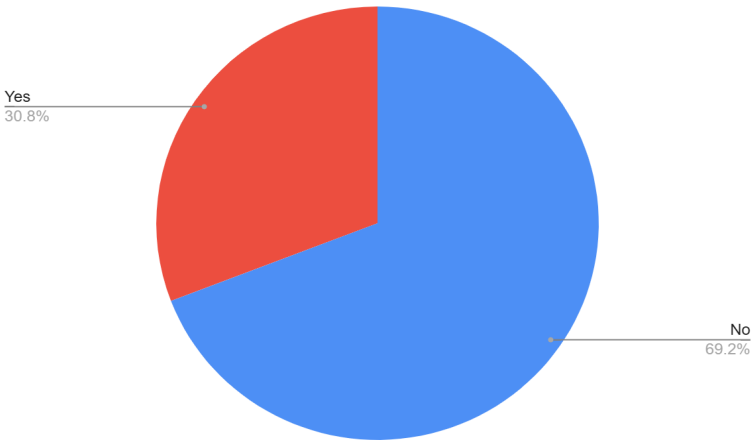


Fig. 2: Participation in IL Training

5.3 IL: Primary Sources for Teaching and Research

Table 1 shows how members of the faculty across disciplines typically find information for teaching and research. 86.7% of the participants rely on traditional internet search engines, while 65.7% who use print books and journals followed by a 47.6% who use library databases. 27.6% consults colleagues for information, while 2.9% use social media. AI platforms like ChatGPT is used by 1% while social media networks like LinkedIn or X are also used by 1%. They form a micro minority. This indicates a strong preference for digital and traditional academic resources with minimal reliance on emerging technologies and social platforms for information gathering.

Table 1: Primary Sources for Teaching and Research

Information Source	Number of Responses	Percentage (%)
Internet search engines	91	86.7
Print books and journals	69	65.7
Library databases	50	47.6
Asking colleagues	29	27.6
Social media	3	2.9
Chat GPT and other AI platforms	1	1
Social media like LinkedIn, X	1	1

5.4 IL: Confidence in Information Seeking Behavior

Table 2 shows that a 73.8% of respondents feel “confident” in their ability to search for and find relevant information, while 19.6% feels “very confident.” 5.6% were “neutral” and none of the respondents rated themselves as “not confident” or “not at all confident.” This suggests that most members of the faculty across disciplines feel assured in their information - seeking skills, with almost all respondents expressing confidence to some degree, indicating a strong overall self-perception of research capabilities.

Table 2: Confidence in Information Seeking Behavior

Confidence Level	Number of Responses	Percentage (%)
Very confident	21	19.6
Confident	79	73.8
Neutral	6	5.6
Not confident	0	0
Not at all confident	0	0

5.5 IL: Frequency of Citation and Referencing Practices in Academic Work

Table 3 represents the context of information use and ethics in the context of IL among members of the faculty across disciplines. 53.8% responded that they “always” use proper citations and references in their academic work, while 30.2% have responded to the question as “often” use citations in their academic practice. 15.1% “sometimes” use citations and 0.9% had responded that they “rarely” cite their sources. It is interesting to note that no one of the respondents said that they “never” cite sources. In the context of ethical information use, this indicates that most educators adhere to proper citation practices, which are essential for academic integrity and avoiding plagiarism. However, the responses that describes “sometimes” or “rarely” in the use of citations suggests the need for reinforcing ethical standards in academic work which can be done through proper training in IL.

Table 3: Frequency in Citation and Referencing Practice in Academic Work

Frequency of Using Proper Citations	Number of Responses	Percentage (%)
Always	57	53.8
Often	32	30.2
Sometimes	16	15.1
Rarely	1	0.9
Never	0	0

5.6 IL: Level of Familiarity with the Concept of Plagiarism

Figure 3 reveals that a 70.1% of respondents are “very familiar” with the concept of plagiarism, while 28% of the respondents are “familiar” with it. 0.9% is “neutral” and another 0.9% indicating they are “unfamiliar” or “very unfamiliar.” The results display that there is a strong overall awareness about plagiarism. This indicates that the members of the faculty and their allegiance to academic integrity. Those who are less familiar with academic integrity highlights a small yet significant gap that needs to be addressed through effective bridging programmes.

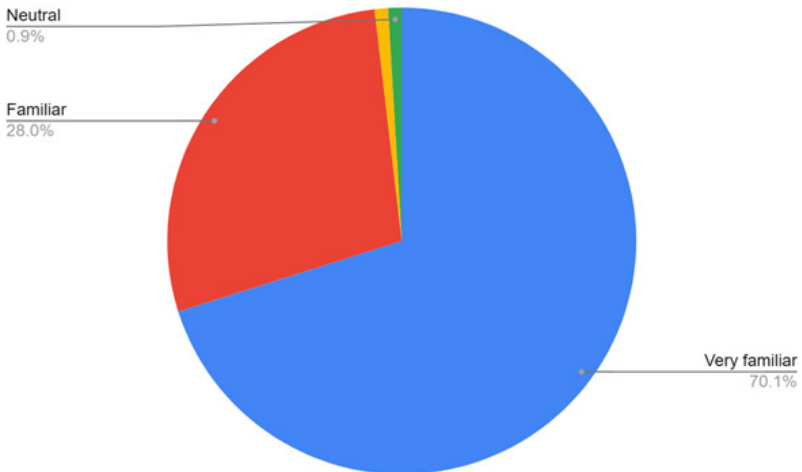


Fig. 3: Level of Familiarity with the Concept of Plagiarism

5.7 IL: Importance of Training Users

Figure 4 shows that 72.9% of respondents mentioned it is “very important” to educate users about IL. 25.2% considers it “important” while 1.9% remained neutral in their responses regarding IL training. A strong recognition among educators about the crucial role that IL plays in user education can be understood through this result. It emphasizes the need for the integration of IL into curricula which in turn will equip learners with essential skills for the effective use of information in the teaching – learning process.

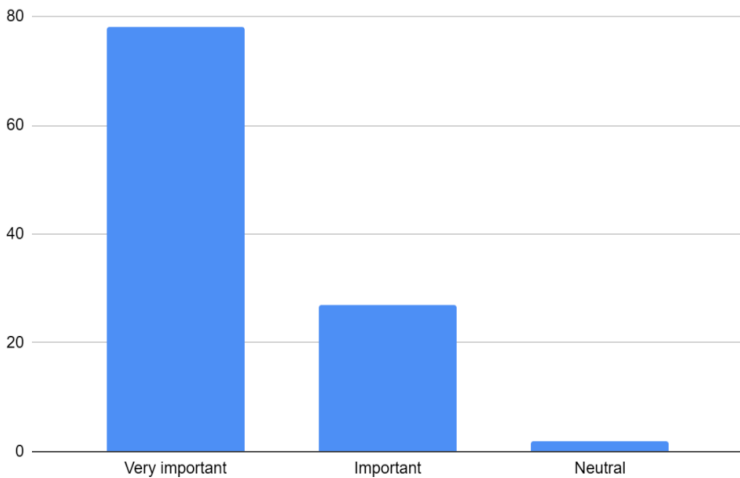


Fig. 4: Importance of Teaching IL to Learners

5.8 IL: Inclusion in Teaching – Learning Process

Figure 5 indicates that 72.6% of includes IL components in their classroom transactions while 27.4% do not include IL components in their classroom transactions. A significant majority of educators understand the need for integrating information literacy into the curricula. The inclusion of these components will improve the learners’ critical thinking and research skills. The effective use of IL in the teaching – learning process enhances the learners’ abilities.

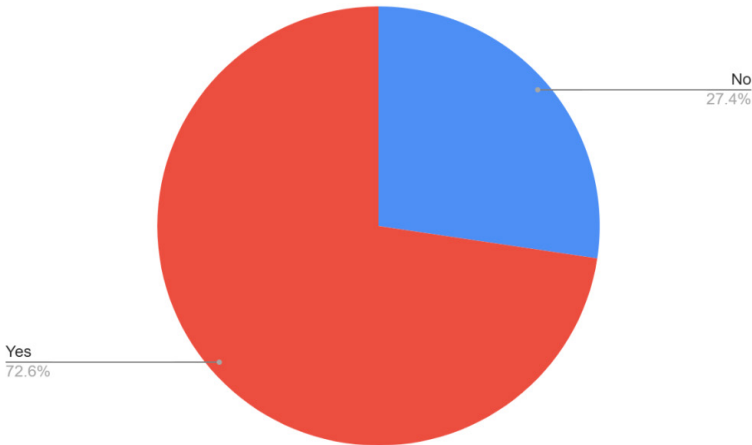


Fig. 5: Inclusions of IL Components in Teaching – Learning Process

5.9 IL: Types of Support

Table 4 shows the modes of IL assistance that the respondents wish to receive. 70.5% needs workshops and training sessions. 63.8% needs online tutorials and guides while 34.3% needs printed manuals and handbooks and 15.2% seek direct one to one conversation to understand IL requirements. 1% has awareness about social media while another 1% has access to journal depositories. The table indicates a rising demand for well structured, formal support systems to enhance the knowledge of IL for members of the faculty across various disciplines.

Table 4: Types of Information Literacy Support

Type of Information Literacy Support	Number of Responses	Percentage (%)
Workshops and training sessions	74	70.5
Online tutorials and guides	67	63.8
One-on-one consultations	16	15.2
Printed manuals and handbooks	36	34.3
Social media posts	1	1
Access to journal repositories	1	1

5.10 IL: Challenges in Accession and Use of Information Resources

Table 5 represents the major issues of the respondents in accessing and using information resources. For 60% of the responses it was “lack of time” while 41.9% responses listed as “limited access to resources” and for 35.2% responses said it as the “lack of training.” 21.9% of responses cited “difficulty in using databases.” 1% of responses reported subjects like “different login credentials” as issues. Constraints in time, availability of resources, and gaps in training are major hurdles pointing to the necessity of expert assistance. Timely assistance will increase accessibility of resources as per the user needs. It offers individualized guidance to train members of faculty across disciplines for the effective use of information resources in the teaching learning process.

Table 5: Challenges in Accessing and Using Information Resources

Challenges in Accessing and Using Information Resources	Number of Responses	Percentage (%)
Lack of time	63	60
Limited access to resources	44	41.9
Difficulty in using databases	23	21.9
Lack of training	37	35.2
Different login credentials for different resources	1	1

The members of the faculty across disciplines had identified the major areas for improving IL in the academic scenarios. Several highlighted the need for IL as the critical element of advanced instruction at the college levels. A majority has advocated for the inclusion of IL in the curricula in all disciplines of study. Time bound and up to date training sessions including workshops and hands on training were suggested to improve the IL related skills for both the teacher as well as the learner.

Ease of access to scholarly articles from other higher education institutions along with up to date resource list are the

major factors leading to higher learning and teaching. Problems related to the balancing of time, ease of using electronic devices are the prominent impediments which necessitates the easy access to higher resources.

6. Recommendations

The following suggestions are made to improve the knowledge and use of IL for better effectiveness.

1. Institutions need to propose IL workshops on a regular basis for all the stake holders of the teaching – learning process.
2. Institutions need to provide user oriented tutorials, guides, and webinars which are open and flexible according to the user needs.
3. Institutions need to include IL in their curricula across all disciplines. Cooperative attempts between IL providers and IL users from the training phase improve the training and using of IL.
4. Institutions need to place further importance on avoiding and detecting plagiarism in their academics. This reinforces academic integrity and ethical use of IL.
5. Institutions need to give better access to the prime research databases across the globe. This should be updated on a regular basis. This expands the research opportunities for all users.

7. Conclusion

This study connects directly to the objectives. It was aimed at assessing the members of faculties across disciplines at college level about their knowledge of IL. The outcomes confirm the hypothesis that there is extensive understanding of the importance of IL. A great part of the responses emphasized the requirement for advanced assets and education about IL. A section of the respondents, those from the regular arts and

science streams were better connected to IL. Constraints of time and issues of access are the major impediments which prevents better participation.

The study highlighted the requirements for improved guidance like regular workshops and hands on training sessions and including IL into the curricula. This reinforces the need for institutional support in developing the IL skills. The research adds to the present knowledge as it displays the crucial role IL has in college level education. It also adds to the necessity for having continuous advanced training along with improved IL resources. New initiatives aimed at understanding and addressing the issues and attempts to making sure that IL is embedded across academic disciplines are needed in the educational scenario of the 21st century.

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MAPPING THE RESEARCH TRENDS ON MENTAL HEALTH LITERACY BY FEMALE GRADUATE

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Abstract

Mental health literacy among female graduate students is a topic that has long deserved more attention than it has received, given

the very real and growing psychological pressures that define life in academia. To better understand how research in this area has evolved, a bibliometric analysis was carried out drawing on nearly five thousand documents with a period of nearly six decades. Findings show that the field that has grown steadily and meaningfully, expanding at an annual rate of around 9%, with a noticeable surge in momentum after 2010 and a peak in scholarly output in 2020. Research in this space is deeply collaborative by nature, with publications averaging almost five authors each, reflecting the kind of cross-disciplinary conversation that complex human issues tend to demand. International collaboration, while still a minority at just over 15% of publications. The Journal of American College Health has served as a particularly important home for this work, hosting over 400 publications, and the most-cited single study. Thus this study highlights urgent need for mental health interventions those are not only evidence-based, but responsive to the gendered and cultural realities that shape the lives of female graduate students around the world.

Keywords: Research Trends, Bibliometric Analysis, Mental Health Literacy, Bradford's Law

1. Introduction

Students are consistently reported high levels of depression, anxiety and stress that interfere with academic performance and well-being (Beiter & *et al.*, 2015; Auerbach & *et al.*, 2018). Students who attend college have significantly higher rates of both mood and anxiety disorders than students who do not attend college level (Blanco & *et al.*, 2008). Multinational studies confirm that mental disorders are prevalent among students around the world regardless of income and institutional settings (Auerbach & *et al.*, 2016). Nearly one-fifth of college students worldwide satisfy diagnostic criteria for a mental disorder (Auerbach & *et al.*, 2018). Across all cultures and socioeconomic rankings, women are disproportionately affected by anxiety and depressive disorders than men (Nolen-Hoeksema, 2001). These gender differences reflect underlying inequalities such as discrimination, differential caregiving responsibilities, workplace discrimination and endemic sociocultural factors (Albert, 2015). Female graduate students

also experience stressors, limited mentorship, and a simultaneous focus on academic and home-life commitments (Mackie & Bates, 2019). Mapping such important issues confirm significant global rise in depression, anxiety and post-traumatic stress in various pandemic-affected populations (Xiong & *et al.*, 2020). Existing bibliometric research has documented the mental health of university students without gender-specific attention; additional research is needed on the academic and non-academic needs of female graduate students (Hernández-Torrano & *et al.*, 2020). Therefore, this study analyses 4,887 Scopus-indexed documents to intellectual map the field of research on the mental health of female graduate students globally (Aria & Cuccurullo, 2017).

2. Objectives of the Study

This study is undertaken with the following objectives:

- To evaluate the growth of publication and average citation related to mental health literacy by female graduate;
- To identify the authorship pattern and author collaboration within this study;
- To find out the most prominent authors and their respective citations within this study.
- To evaluate different types of documents used and identify the most prevalent document type.
- To find out relevant sources and most globally cited documents.

3. Methodology

Bibliometric analysis is used as methodology of this study. Bibliometric is an analysis which evaluates large volume of publication and citation offer from a database such as Scopus. Scopus database was selected for the extensive coverage of high-quality, peer-reviewed literature and its robust bibliometric data which make it a standard source for such analyses (Baas, et al. 2020). The current study is undertaken to measure the pattern

and publication trend on the mental health of female graduate students globally and data base is downloaded from Scopus on February 19, 2026. The data has retrieved with the syntax TITLE-ABS-KEY ((“mental health literacy” OR “mental health”) AND (“female graduate*” OR “women graduate*” OR “graduate women”). Initially, a total 5021 documents were received from Scopus and after checking the duplication or irrelevant data 4,887 documents were finalized from the year 1967 to 2025. The data has been evaluated by using Biblioshiny software (Aria & Cuccurullo, 2017) and for graphical representation MS excel has been used.

4. Results

4.1 Dataset Overview

The data set consists of 4,887 documents published between 1967 and 2025 across 1,133 sources such as peer-reviewed journals, books, and other scholarly publications. The study has achieved a growth rate of 9.02% per study year, which indicate progressive and constant growth of research effort. The average number of citations per document being 33.16 suggests that the literature has made a significant impact. The dataset contains 33,833 references, reflecting the strength and cross-disciplinary connections of knowledge. The publication age of 7.89 years suggests that the dataset includes fundamental, classical and recent empirical research.

4.2 Annual Scientific Production

Figure 1 shows the distribution of the output reveals with a steady growth in the number of documents published during each year. This early period (1960s to 1990s) saw low output levels, indicative of the fledgling and relatively undistinguished nature of research on graduate student well-being. A clear increase in growth rate occurred around 2010 which coincide with the growing global recognition of the mental health of graduate students as a unique and important public health issue. The peak in annual output occurred in 2020. The upward trend

in the years demonstrates that the research focus on this topic is a steadily-growing academic concern, rather than an ephemeral response to a crisis.

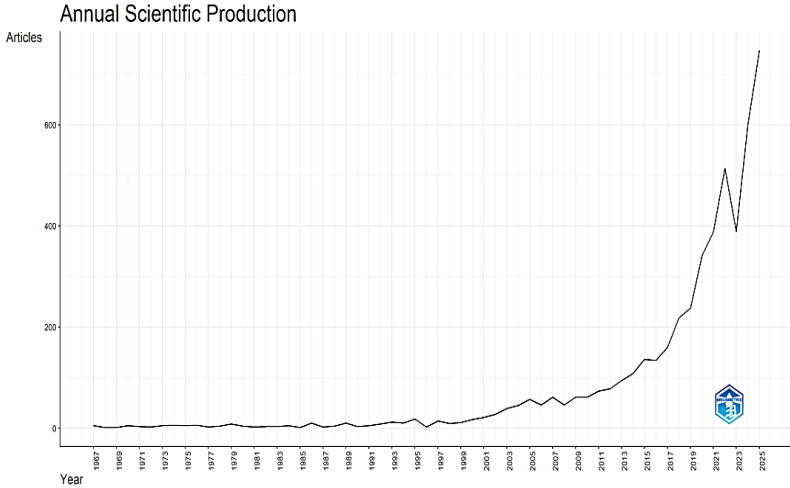


Figure: 1 Annual Scientific Production on the Mental Health of Female Graduate Students

4.3 Authorship and Collaboration Patterns

Table: 1 shows that the dataset includes 19,149 authors and 4,887 documents which reveals the involvement of a diverse group of authors in this area. There are 265 single-authored documents and the average number of authors per publication is 4.99, suggesting a strong culture of collaboration in the field. Trans-national collaboration figures at 15.43% of total publications, indicating that while there is global collaboration, there is plenty of intra-national research taking place too.

Table 1. Authorship Collaboration Pattern

Description	Results
Total Authors	19,149
Single-Authored Documents	283
Mean Co-Authors per Document	4.99
International Co-Authorship (%)	15.43

4.4 Most Productive Authors

Table: 2 highlights the top ten highly productive authors who make a disproportionate contribution to the research published in this field. The highest number of publications was 51 by Daniel Eisenberg, who also has the highest fractionalised score (11.30) which suggests significant independent impact by publishing sole-authored works. Ronny Bruffaerts and Philippe Mortier authored 30 each and Randy P. Auerbach and Ronald C. Kessler published 28 each. Pim Cuijpers (27), David Daniel Ebert (26), Corina Benjet and Sarah Ketchen Lipson (22 each) and Cindy Hsin-Ju Liu (18) rounds out the top ten.

Table 2. Top Ten Productive Authors

Author	Articles	Articles Fractionalized
Eisenberg, Daniel	51	11.30
Bruffaerts, Ronny	30	1.78
Mortier, Philippe	30	1.92
Auerbach, Randy Patrick	28	1.60
Kessler, Ronald C.	28	1.73
Cuijpers, Pim	27	1.58
Ebert, David Daniel	26	1.68
Benjet, Corina	22	1.20
Lipson, Sarah Ketchen	22	5.01
Liu, Cindy Hsin-Ju	18	3.31

4.5 Document Types

Table: 3 shows that the most common type of document is the peer-reviewed journal article, which represents 4,672 out of 4,887 documents in the dataset (95.6% of the total publications). The next largest document type is review articles 116 documents, followed by conference papers (27), letters (18), notes (18), retracted documents (12), editorials (8), errata (7), short surveys

(7) and book chapters (2). The major representation of journal articles confirms that empirical, rigorously peer-reviewed research is the primary source through which knowledge is communicated in this research field, in line with other studies of a similar nature.

Table 3. Distribution of Document Types

Document Type	Frequency	Percentage (%)
Article	4,672	95.6
Review	116	2.4
Conference Paper	27	0.6
Letter	18	0.4
Note	18	0.4
Retracted Document	12	0.2
Editorial	8	0.2
Erratum	7	0.1
Short Survey	7	0.1
Book Chapter	2	0.04

4.6 Source Distribution

Table: 4 reveals the highly concentrated research output in a small number of high-impact journals. The Journal of American College Health tops the list with 409 publications with its history as the leading forum for college or collegiate health. The International Journal of Environmental Research and Public Health (251) suggests the dominance of public health, and Journal of Affective Disorders (124), Frontiers in Psychiatry (120), PLOS ONE (102), Frontiers in Public Health (74), Scientific Reports (66), BMC Psychiatry (60), the Chinese Journal of Clinical Rehabilitation (54), and BMC Psychology (53) comprise the remainder of the top ten. The Journal of Affective Disorders (124), Frontiers in Psychiatry (120), PLOS ONE (102), Frontiers in Public Health (74), Scientific Reports (66), BMC

Psychiatry (60), the Chinese Journal of Clinical Rehabilitation (54) and BMC Psychology (53) complete the top ten publication sources. The inclusion of journals from disciplines as varied as clinical psychiatry, public health, psychology and the social sciences further demonstrates the interdisciplinary nature of the field.

Table 4. Top Ten Publication Sources

Source	Numbers
Journal of American College Health	409
International Journal of Environmental Research and Public Health	251
Journal of Affective Disorders	124
Frontiers in Psychiatry	120
PLOS ONE	102
Frontiers in Public Health	74
Scientific Reports	66
BMC Psychiatry	60
Chinese Journal of Clinical Rehabilitation	54
BMC Psychology	53

4.7 Core Sources: Bradford's Law

The application of Bradford's Law to the source distribution also confirms that there is a small core of highly productive journals that are responsible for generating a disproportionate share of the literature related to the topic (Figure 2). The Bradford scatterplot demonstrates three separate zones of journal productivity: a core zone, which includes a nucleus of highly productive journals that account for the bulk of research output; and two more peripheral zones in which productivity gradually decreases. This three zone structure is typical of well-established fields of research (Bradford, 1934; Suseleih, 2021) and confirms the role of a small number of influential journals in organising scholarly discourse on this topic.

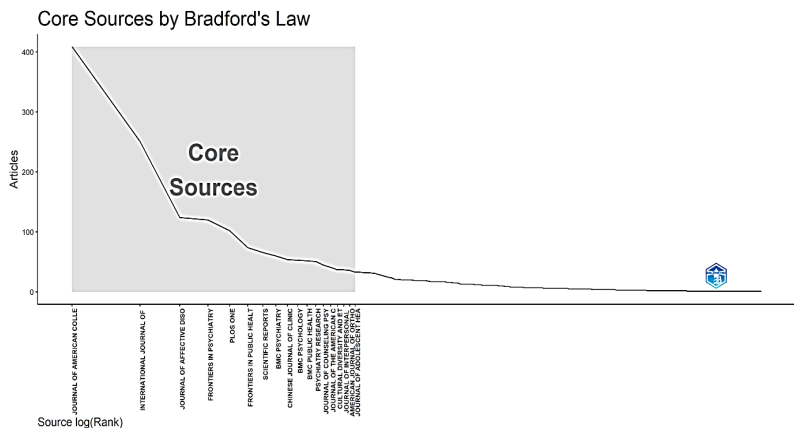


Figure 2. Bradford's Law — Core Sources Distribution

4.8 Top Ten Globally Cited Documents

The citation analysis reveals the most widely cited publications, which have played a key role in the development of this field (Table 5). Cao et al. (2020) from the journal Psychiatry Research leads with 3,929 citations and an annual citation rate of 561.29; makes it the most cited study of the mental health effects of COVID-19 on university students. Son et al. (2020) ranks second with 1,937 citations and Auerbach et al. (2018), which reports worldwide prevalence of mental disorders among university students, ranks third with 1,724 citations. The citation of key theoretical publications, such as Pargament (2000), on religious coping and Kasser (1993), on motivation and well-being, shows the field draws information and inspiration from longstanding theory and modern empirical research. The inclusion of several pandemic-related articles in the top ten highlights that a shift in research focus towards mental health challenges tied to global crises has occurred since 2020.

Table 5. Most Globally Cited Documents

Paper	Total Citations	Total Citation per Year	Normalised Total Citation
Cao et al. (2020), Psychiatry Research	3,929	561.29	58.96

Son et al. (2020), J. Medical Internet Research	1,937	276.71	29.07
Auerbach et al. (2018), J. Abnormal Psychology	1,724	191.56	30.66
Pargament (2000), J. Clinical Psychology	1,689	62.56	9.27
Kasser (1993), J. Personality and Social Psychology	1,523	44.79	10.87
Lund et al. (2010), J. Adolescent Health	1,363	80.18	18.67
Beiter et al. (2015), J. Affective Disorders	1,259	104.92	21.30
Blanco et al. (2008), Archives of General Psychiatry	1,253	65.95	10.48
Auerbach et al. (2016), Psychological Medicine	1,137	103.36	24.20
Wang et al. (2020), J. Medical Internet Research	1,087	155.29	16.31

Note. TC = Total Citations; TC per Year = mean annual citations since publication; Normalized TC = citation impact adjusted for document age.

5. Discussion and Conclusion

This bibliometric analysis offers a holistic overview of global research on female graduate student mental health over the past 58 years and identifies several insights about the structure, development, and intellectual structure of this research field. Annual growth of 9.02% confirms that this field of research has experienced significant sustained growth, as reflected also in student mental health research bibliometrics worldwide (Hernández-Torrano et al., 2020). The marked acceleration of growth after 2015 and the sudden surge in publications centred on 2020 correspond to broader trends in mental health bibliometrics (Sweileh, 2021; Naeim et al., 2026), and are largely due to the impact of the COVID-19 pandemic, which triggered a remarkable mobilisation of research capacity towards the psychological implications of prolonged isolation,

disruption to education, and socioeconomic hardship among university students (Cao et al., 2020; Son et al., 2020; Xiong et al., 2020). Geographic concentration of research activity is a key structural insight of this research whereas earlier study shows the US contribution (42.1%) with the considerable investment in research infrastructure and well-funded graduate students that support mental health research in the US (Patel et al., 2018).

Thus this study highlights a holistic overview of 4,887 studies concerning the mental health of female graduate students (1967-2025) published in databases sourced from the Scopus database and analyzed in Biblioshiny. The reports of emerging journals, prolific authors, key institutions and geographies provide critical evidence for researchers, institutions and policy. Continued geographic inequities in research engagement, as well as an under-representation of female graduate students as a discrete population of interest vis-à-vis gender disaggregated bibliometric studies, identify key areas for future research. Multidisciplinary studies, integration across multiple databases, and increasing collaboration across borders are critical to achieving a more representative, valuable and inclusive view of the mental health issues facing this population.

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AWARENESS AND USAGE OF AI TOOLS FOR ACADEMIC WRITING AND RESEARCH AMONG THE UNIVERSITY ACADEMIC COMMUNITY: A STUDY

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Abstract

This study investigates the awareness of a selected group of research scholars and faculties within the Assam Agricultural University, Jorhat, Assam. Taking into account the Similarity and AI detection reports of dissertations, theses, project proposals and articles generated through Turnitin Anti-plagiarism software, data were collected from a total of 40 respondents including MSc, PhD and faculties of Assam Agricultural University by adopting purposive sampling method. Findings reveals that users consider AI as a useful tool for enhancing academic writing and information access but lack guidance in using AI for their research activities. Differences in perception were influenced by uncertified verbal communication among their fellow scholars, as

well as statements made by self-acclaimed experts in the academic community thereby circulating worries and fear of committing academic misconduct. The summarized results highlight the inclusion of focused training, building mentorship and ethical integration of AI tools in library services to encourage responsible AI application in academic research.

Keywords: Artificial Intelligence (AI), ethical integration of AI, academic writing, research, academic misconduct

1. Introduction

In traditional education, students are encouraged to take an active role in their learning process by developing skills in exploration, analysis, and problem solving. Critical thinking skills are essential for shaping students' overall learning experiences (Facione, 2020). However, the rapid information processing and insightful responses provided by AI challenge traditional learning methods, raising questions about the distinctions between human learning and machine-based learning (Luckin et al., 2016). The effective integration of artificial intelligence in education requires a thorough understanding of both the technology and the learning process. This complexity is further heightened by ethical concerns, especially in the context of the increasingly use of generative AI (Qadir, 2023). Higher education institutions must clearly define the role and extent of AI in student education to address these challenges effectively (Holmes & Tuomi, 2022). The integration of AI in academic environments raises critical questions related to equality, accessibility and the evolving role of traditional teaching methods (Hennekeuser et al., 2024). Universities have a responsibility to provide their students with up-to-date efficient and relevant learning tools. Universities also have a responsibility to respond to the rapidly changing technological landscape, which includes AI as an increasingly prominent feature (Bearman et al., 2023). Khalifa et al. (2024) identified 24 studies based on six core domains where AI is helpful in academic writing and research such as facilitating idea generation and research design, improving content and

structuring, supporting literature review and synthesis, enhancing data management and analysis, supporting editing, review and publishing, assisting in communication, outreach and ethical compliance. While academic writing can be challenging, AI tools greatly aid in this process enhancing research productivity and improving work efficiency (Dwivedi, et al., 2023)

To address this matter, this study aims at assessing the awareness, usage, and perception of AI among the students, scholars and faculties (all are represented as users) of Assam Agricultural University, Jorhat during their research work for MSc dissertations and PhD theses. While using AI it is important to determine the perception of the users in adopting this technology as they are the active information seekers in the academic environment. The primary objective is to conduct a comprehensive survey of these factors and measure the awareness level of the respondents of the study. The result of the study aims to provide an evidence-based data on adopting strategies to ethically improve the research centric activities of the user community.

2. Objective of the study

- To examine the impact of AI technologies on the learning process and academic performance of the users of the Assam Agricultural University.
- To examine the awareness level of the users with the AI tools and the types of AI application for learning, research and creative work.
- To investigate the perception of AI application with regard to enhancing efficiency, information accessibility, learning and research support

3. Methodology

• Research Design

The study employed a quantitative, descriptive research design to examine user awareness, their perceived usefulness and risks and ethical perception of AI across the users.

- **Target population**

The study comprises of the similarity reports generated for the theses and dissertations of PhD and PG students submitted during the period 2024-2025 and 2025-2026 as well as the project proposals prepared by faculties of AAU in 2025 for submission to ICSSR.

- **Sampling method and sample size**

Using purposive sampling (Vieriu & Patrea, 2025), a total of 40 similarity reports of MSc students, PhD scholars and faculties generated from Turnitin anti-plagiarism software were selected to ensure the impact of AI and its awareness among the respondents. These are segregated as

1. 20 dissertations selected randomly comprising various departments with both similarity and AI detection reports submitted during the academic sessions 2024-2025 and 2025-2026.
2. 13 theses selected randomly comprising various departments with both similarity and AI detection reports submitted during the academic sessions 2024-2025 and 2025-2026.
3. 7 project proposals and articles comprising all the departments, colleges and KVKs with similarity and AI detection reports submitted in 2025.

- **Research instrument**

To detect the AI level in the research studies of the respondents, the Turnitin anti-plagiarism software has been taken as the tool wherein the data can be accessed through the similarity reports generated from Turnitin software and a structured questionnaire which was shared with the respondents whose similarity reports were selected for the study. The questionnaire comprised of 12 questions categorized into two types of questions out of which 7 questions were open-ended questions to quantify the responses and 5 closed-ended questions

for insightful information on the respondents' perception, experiences and ethical awareness on the impact of AI tools in their learning.

4. Date Analysis and Interpretation

Table 1: No. of dissertations, theses and projects reports randomly selected for the study

Department/Colleges/KVKs	MSc	PhD	Faculties
Agronomy	3	2	
Agri. Biotechnology	3	4	
Agri. Economics	4	2	
Extension Education	1		
Nematology	1		
Biochemistry	2	1	
Horticulture	2	1	1
Plant Pathology	1	1	
Plant Breeding & Genetics	2		1
Food Science & Nutrition		2	
HDFS	1		4
KVK (Diphu)			1

Table 2: Similarity Index of the plagiarism reports generated (with a threshold of 10%)

Department/Colleges/KVKs	MSc	PhD	Facult.	MSc	PhD	Facult.
Similarity Index (SI)	SI $\leq$ 10%			SI > 10%		
Agronomy	2	1		1	1	
Agri. Biotechnology	1	3		2	1	
Agri. Economics	2	1		2	1	
Extension Education	1			0		
Nematology	0			1		
Biochemistry	1	1		1	0	
Horticulture	2	1	1	0	0	0
Plant Pathology	0	1		1	0	
Plant Breeding & Genetics	1		1	1		0
Food Science & Nutrition		2			0	
HDFS	1		4	0		0
KVK (Diphu)			1			0

The number of MSc students with $SI \leq 10\% = 11$ (55%);
 $SI > 10\% = 9$ (45%)

The number of PhD scholars with $SI \leq 10\% = 10$ (76.9%);
 $SI > 10\% = 3$ (24%)

The number of faculties with $SI \leq 10\% = 7$ (100%); $SI > 10\% = 0$

*Table 3: Artificial Intelligence % detected from the reports
generated (with a threshold of 30%)*

Department/Colleges/KVKs	MSc	PhD	Facult.	MSc	PhD	Facult.
Artificial Intelligence (AI)	AI $\leq 30\%$			AI $> 30\%$		
Agronomy	1	0		2	2	
Agri. Biotechnology	1	3		2	1	
Agri. Economics	1	1		3	1	
Extension Education	1			0		
Nematology	0			1		
Biochemistry	1	0		1	1	
Horticulture	2	0	1	0	1	0
Plant Pathology	0	0		1	1	
Plant Breeding & Genetics	1		0	1		1
Food Science & Nutrition		2			0	
HDFS	1		1	0		3
KVK (Diphu)			1			0

The number of MSc students with $AI \leq 30\% = 9$ (45%);
 $AI > 30\% = 11$ (55%)

The number of PhD scholars with $AI \leq 30\% = 6$ (46.15%);
 $AI > 30\% = 7$ (53.8%)

The number of faculties with $AI \leq 30\% = 3$ (42.8%); $AI > 30\% = 4$ (57.14%)

Table 1 states that the number of PG students is more in comparison to PhD and faculties with regard to research work. However, the PhD and faculties study vast information for which their work needs much time, large data sets and in-depth study.

From the above data in table 2, it is understood that respondents with plagiarism below 10% is greater than those with plagiarism above 10%. The reason arrived at is that all the respondents are aware that the acceptable SI % as per University Anti-plagiarism guidelines is 10% and therefore, they give much effort in limiting to the desired SI. Also, the higher the respondents' degree demands, their awareness towards plagiarism improves. In case of faculties, it shows a very positive output.

In case of AI detection, highlighted in table 3, it provides a mixed results for all the respondents. When interacted through closed-ended questions, the opinions of all the respondents vary from one another. The responses could be categorised as positive and negative responses. The variations identify the awareness and approach to AI applications by the respondents. Maximum of the respondents are in favour of using AI but remain less aware of the manner in which AI tools need to be handled.

Table 4: Perceived usefulness of AI tools

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
AI helps complete task more efficiently	4.1	5	8.3	51.2	31.4
AI improve the quality of academic or work-related content	2.5	5.8	18.2	53.7	19.8
AI application is time efficient	0.8	5	27.3	41.3	25.6
AI is useful for learning new topics or skills	1.7	2.5	12.4	50.4	33
AI helps make better decisions	4.7	8.8	35.4	33.9	17.2
AI enhances the library services	10.7	24	33.1	24.8	7.4
AI is beneficial for planning and organising tasks	3.3	9.1	29.7	40.5	17.4
AI improves access to information and resources	5.8	12.4	16.5	39.7	25.6
AI is indispensable for education and self-development	0.7	5	18.2	33.1	43

Table 4 illustrates respondents' perceptions of the usefulness of artificial intelligence (AI) technologies across various functional and experiential dimensions.

- Firstly, a majority of respondents recognized AI's role in improving task efficiency, with 51.2% agreeing and 31.4% strongly agreeing that AI helps them complete tasks more efficiently. Only a small portion (9.1%) expressed disagreement, while 8.3% remained neutral. This suggests that most participants perceive AI as a practical tool that enhances productivity and streamlines work processes.
- While 73.5% of respondents collectively agree and strongly agree that AI tools improve the quality of their academic or work-related content, indicating strong confidence in AI's capacity to support intellectual and creative outputs. On the other hand, disagreement (8.3%) was less and 18.2% remained neutral, implying that while the majority find AI beneficial, some users may still question its reliability or authenticity in professional or academic contexts.
- Regarding time efficiency, a combined 66.9% of respondents agreed or strongly agreed that AI applications save them time in daily activities, with only 5.8% in disagreement. The notable 27.3% neutrality could reflect varying degrees of engagement with AI tools, as users who apply AI less frequently may not yet perceive clear time-saving benefits.
- With 83.4% of participants agreeing or strongly agreeing that AI is useful for learning new topics or skills reflects an openness among library users to leverage AI as a learning aid, aligning with the library's educational mission.
- For decision making purpose, while collectively 51.1% agreed or strongly agreed that AI helps them make better-informed decisions, 35.4% remained neutral, and 13.5% all together disagreed. This ambivalence may stem from users' uncertainty about AI's accuracy or ethical implications in decision-making contexts, especially where human judgment remains essential.

- In contrast, respondents showed relatively positive views regarding AI's usefulness in planning and organization, with 57.9% agreeing or strongly agreeing, compared to 12.4% who disagreed. The 29.7% neutral responses may again reflect differences in the extent to which users actively integrate AI tools into their personal management routines.
- With a high positive response towards AI as a learning aid, it is noticed that 76.1% affirmed that AI is valuable in education and self-development, underscoring AI's perceived importance as a tool for continuous learning and personal growth.
- Regarding access to information and resources, 65.3% of respondents agreed or strongly agreed that AI enhances access, though 18.2% expressed some level of disagreement. This positive response aligns with AI's capacity to streamline information retrieval, customize recommendations, and improve accessibility in digital library environments.

Table 5: AI tools used by the respondents

AI tool	MSc	PhD	Faculties
ChatGPT	20	13	7
Perplexity	11	4	3
Google Gemini	17	11	3
Grammarly	19	13	6
Microsoft Copilot	8	5	2

Table 5 illustrates the AI tools used by the respondents where it is seen that ChatGPT is the most preferred and common AI tool used by 100% respondents, followed by Grammarly and Google Gemini. However, Perplexity and Microsoft Copilot are lesser used tools. It is found that ChatGPT is so familiar to the respondents that they use it for every kind of information search not alone research and academics. Grammarly, on the other hand, is a tool that is discussed about and frequently used among

the academic community and also passed on from previous researchers. They are aware that Grammarly provides them with features such as spellcheck, paraphrase, similarity check etc which enhances their writing skills thereby making their research output presentable. However, it has been understood that the respondents do not possess the knowledge about the type of AI tools used for different purpose in academic writing and this can be argued to be due to lack of awareness, ignorance as well as need for talks, workshops and discussion on AI tools and their applications on various academic platforms.

5. Results and discussion

The findings reveal ethical consciousness among the respondents who consistently emphasized the need for transparency, fairness, privacy protection, and developer accountability. These attitudes underscore that while users welcome AI's integration into everyday life, they demand that it be guided by strong ethical principles – principles that libraries, as trusted community institutions, are well-positioned to promote through literacy initiatives and informed dialogue.

The detailed findings revealed that the usefulness of AI is many fold yet there are apprehensions as well.

1. It serves as a productivity enhancement tool and streamlines work processes
2. AI has been adopted as a learning aid, aligning with the new academic challenges.
3. AI tools are actively integrated into users' personal management routines.
4. AI has a broad spectrum to streamline information retrieval and improve accessibility to the various aspects of producing quality research.

However, there are also discouraging inferences such as reliability or authenticity issues and a vague perception on the benefits of using AI. In this regard, awareness and orientation

programs must be introduced through the academic libraries as these institutions play a prominent role in fostering academic integrity and research productivity.

AI tools must be approached with the objective of enhancing the academic writing process. The users must be responsible enough to verify the accuracy and appropriateness of AI-generated contents, ensuring that it does not affect the originality of their work.

6. Conclusion

The adoption of AI tools in the academic environment, indicates in-depth knowledge on AI. When universities nurture a more knowledgeable and skilled academic community, they can improve the quality and efficiency of research, which in turn enhances the entire scholarly environment. Additionally, focusing more on ethical AI practices is crucial for addressing the challenges of data privacy, bias, and authorship. This approach helps ensure that using AI in research maintains the integrity and rigour that academia requires. Moreover, a deeper understanding of AI's interplay with educational theories, alongside addressing ethical and pedagogical challenges is important.

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BEYOND CATALOGS: INFORMATION PROFESSIONALS AS ARCHITECTS OF CYBER RESILIENCE

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Abstract

The accelerated digital transformation across sectors such as Digitised Architecture, Engineering, Construction, and Operations (DAECO) and public administration has elevated information to a strategic asset while simultaneously exposing it to unprecedented vulnerabilities. This conceptual article synthesizes three complementary bodies

of research—the Information Resilience Framework from the construction sector, organizational governance models for cyber resilience in academia, and pedagogical approaches to cultivating self-efficacy in cybersecurity education—to propose an integrated architecture for cyber resilience. The synthesis reveals that effective information resilience requires a tripartite foundation: (a) cognitive-driven capabilities of people, including attention, reasoning, perception, and learning, operationalized through behaviors such as sense-checking, data interrogation, and methodological decision-making; (b) process-driven requirements, including validation checks, standardization, training, collaboration, automation, and continuous monitoring across the information lifecycle (create, use, store, reuse, preserve, destroy); and (c) the attitudinal foundation of self-efficacy comprising motivation and self-awareness, curiosity and lifelong learning, dependability and attention to detail, and resilience, flexibility, and agility. The article argues that information professionals must evolve from passive custodians of data to proactive architects of resilience, integrating these three layers within supportive organizational governance structures such as federated academic networks (e.g., Academic CERT Associations) and maturity models for effectiveness, efficiency, and cyber resilience. Practical implications include the design of cybersecurity curricula that explicitly map learning objectives to self-efficacy attitudes, the implementation of reflective activities such as SWOT analyses for competency assessment, and the adoption of skills-first approaches to talent development. The paper concludes that cyber resilience is not a product of technology alone but an emergent property of efficacious, cognitively skilled professionals operating within resilient processes and governance frameworks. Future research directions include developing validated measurement instruments for domain-specific self-efficacy and testing integrated interventions across diverse organizational contexts.

Keywords: Cyber Resilience, Information Quality; Self-efficacy; Information Professionals; Cognitive Capabilities; Process Requirements; Organizational Governance; Upskilling; Information Lifecycle; Socio-technical Systems

1. Introduction

The accelerating digital transformation of contemporary society has elevated information from a byproduct of operations to a strategic asset. Nowhere is this more pronounced than in data-intensive sectors such as the Digitised Architecture, Engineering, Construction, and Operations (DAECO) industry and the broader public administration. However, this reliance on digital information introduces significant vulnerabilities. Threats to information quality ranging from human error and process inconsistencies to sophisticated cyber-attacks compromise the intrinsic, relational, and security dimensions of data, thereby undermining organizational resilience. Traditional approaches to information management have often focused on reactive security measures. This conceptual article argues that information professionals must evolve from custodians of data to proactive architects of cyber resilience. By synthesizing findings from a resilience framework for DAECO Blay et al.,(2020), a governance model for the academic sector Shalamanov (2019), and pedagogical strategies for cultivating self-efficacy in cybersecurity Stavrou & Piki (2024), this article identifies a tripartite foundation for cyber resilience: cognitive-driven capabilities, process-driven requirements, and the attitudinal foundation of self-efficacy.

The modern landscape of information management is further complicated by the pervasive deployment of emerging technologies, such as Artificial Intelligence (AI), Machine Learning (ML), Generative AI, and the Internet of Things (IoT). While these innovations optimize organizational efficiency and data processing, they simultaneously introduce complex, automated threat vectors that significantly expand the institutional attack surface. Threat actors increasingly leverage Generative AI to design hyper-targeted social engineering schemes, bypassing algorithmic defenses by directly exploiting human cognitive biases. Furthermore, these technical advancements bring critical ethical challenges including data privacy risks, systemic algorithmic biases, and proprietary intellectual property vulnerabilities that

traditional security frameworks fail to address. Consequently, cyber resilience can no longer be approached purely through software patches or hardware perimeter controls; it demands a robust socio-technical perspective that positions information quality and data ethics at the core of organizational defense.

To address these vulnerabilities, this study outlines an integrated conceptual framework that redefines the architectural responsibilities of information professionals. The subsequent sections explore the multi-dimensional nature of cyber resilience by breaking down its micro- and macro-level dependencies. First, we understand the vulnerabilities inherent across the information lifecycle spanning creation, use, storage, reuse, preservation, and destruction. We then unpack the operational pillars of this architecture: individual cognitive-driven capabilities (such as critical data interrogation and vigilance) and process-driven requirements (including validation checks and lifecycle standardization). Finally, the study analyzes the macro-level organizational governance structures necessary to scale these practices and details the pedagogical strategies required to foster self-efficacy as the psychological foundation for continuous digital upskilling. Through this comprehensive synthesis, the study provides a practical blueprint for transforming information professionals into active architects of institutional resilience.

2. Review of literature

The conceptual paradigm of cyber resilience marks a fundamental shift from traditional perimeter-defense security to dynamic system adaptability. Linkov and Kott (2019) established that systems must transcend passive defense, engineering capacities to anticipate, withstand, recover from, and actively evolve following adverse cyber events. While this dynamic systems-based perspective provides a macro-level foundation, it frequently abstracts the micro-level mechanics of the data moving through these networks. This granular gap is partially addressed by Batini and Scannapieco (2016), who argue that data and information quality defined through dimensions of

accuracy, consistency, and validity serve as the core currency of any organizational defense mechanism.

However, a critical limitation in current literature is the siloed treatment of these concepts. Technical cyber security frameworks often relegate information quality to a byproduct of system uptime, while traditional information management literature treats data curation completely separate from active adversarial cyber threats. Blay et al. (2020) bridged part of this divide through the Information Resilience Framework, mapping explicit vulnerabilities across the information lifecycle (creation, storage, preservation, and destruction) and introducing cognitive and process requirements. Yet, Blay et al.'s framework remains localized within specific, highly structured corporate sectors like the Digitised Architecture, Engineering, Construction, and Operations (DAECO) industry, leaving its applicability to highly distributed, open-access environments such as academic networks and libraries largely untested.

Furthermore, macro-level governance models, such as the Effectiveness, Efficiency, and Cyber Resilience (E2CR) model proposed by Shalamanov (2019), emphasize federated networks like the Academic CERT Association (ACERTA). While these models successfully address structural scaling and institutional resource-sharing, they treat human capability as an external resource to be plugged into a maturity model, overlooking the behavioral and psychological dynamics that govern actual human performance during a cyber crisis.

This oversight underscores the importance of psychological constructs in socio-technical security. Maddux and Mendis (2025) note that self-efficacy directly dictates professional adaptability, motivation, and cognitive endurance under stress. Similarly, Stavrou and Piki (2024) successfully operationalized this construct within educational curricula, demonstrating that structured pedagogical interventions can build long-term commitment to digital re-skilling and lifelong learning in cybersecurity.

2.1. Research Gaps Identified

A critical analysis of the extant literature reveals a profound disconnect among the human, process, and governance dimensions of cyber resilience, which are typically examined in isolation rather than as an integrated socio-technical ecosystem. While pedagogical research independently addresses individual self-efficacy, operational frameworks emphasize process standards, and policy literature focuses on macro-governance, current scholarship fails to conceptualize how these distinct layers interlock. This fragmentation directly creates a need to synthesize these theoretical frameworks to examine the changing, increasingly vital role of information professionals within the modern digital ecosystem. Furthermore, a significant gap exists in how information professionals are positioned within active defense architectures; they are traditionally relegated to passive data custodianship and systematically omitted from technical security frameworks despite their unique expertise in data lifecycle verification and information quality management. By identifying these deficiencies, this study directly addresses these gaps by proposing an integrated, practitioner-led conceptual framework and suggesting practical strategies for curriculum design and professional development to transform information professionals into proactive architects of institutional cyber resilience.

2.2. Problem Statement

The rapid expansion of digital technologies and the increasing dependence on information-driven systems have significantly transformed the way organizations create, manage, store, and access information. While this digital shift has enhanced operational efficiency and service delivery, it has also introduced new vulnerabilities related to information quality, cybersecurity threats, data breaches, and system disruptions. In many institutions, cyber resilience is still predominantly viewed as a technological concern, with primary emphasis placed on software, hardware, and network security solutions.

However, such approaches often overlook the critical human and organizational dimensions of resilience, particularly the role of information professionals in safeguarding, managing, and sustaining trustworthy information systems. Despite their central involvement in information lifecycle management, the evolving responsibilities of information professionals as contributors to cyber resilience remain underexplored in existing literature and practice. Therefore, there is a need to conceptualize a broader framework that positions information professionals not merely as custodians of information, but as active architects of cyber resilience within increasingly complex digital environments.

3. Objectives of the study

1. To examine the changing role of information professionals in the cyber-resilient digital ecosystem.
2. To synthesize existing theoretical frameworks related to information resilience, governance, and self-efficacy.
3. To propose an integrated conceptual framework for cyber resilience led by information professionals.
4. To suggest practical strategies for curriculum design and professional development.

4. Methodology

This study adopts a qualitative, conceptual synthesis approach, executing a rigorous literature search across Scopus, Web of Science, IEEE Xplore, and Google Scholar. Using Boolean combinations of keywords like “cyber resilience,” “self-efficacy,” and “information professionals,” scholarly literature was purposively selected. Inclusion criteria required peer-reviewed, socio-technical studies, while purely hardware-centric papers were excluded. A thematic analysis method was then employed to identify recurring dimensions and conceptual linkages, directly informing the integrated cyber resilience framework developed for the present study to define the evolving role of information professionals.

5. Key Dimensions of Cyber Resilience

To understand the evolving role of information professionals in building cyber resilience, it is essential to examine the major dimensions that collectively contribute to resilient information ecosystems. Drawing from existing theoretical and empirical literature, the present study identifies four interconnected thematic areas that form the foundation of the proposed framework. These include the vulnerabilities associated with the information lifecycle in increasingly digitised environments, the capabilities and process requirements necessary for ensuring information resilience, the role of organizational governance and collaborative networks in strengthening institutional preparedness, and the importance of self-efficacy as a psychological driver for continuous learning and professional re-skilling. The following sections discuss each of these dimensions in detail to establish a comprehensive understanding of cyber resilience from an information professional's perspective.

5.1. The Vulnerable Information Lifecycle in Digitised Environments

The quality of information is crucial for successful asset delivery and management. In the DAECO sector, information is not static; it moves through a lifecycle of creation, use, storage, reuse, preservation, and destruction (Blay et al., 2020). At each stage, information is susceptible to threats. Blay et al. (2020) demonstrated that these threats emerge from four primary sources: people (e.g., lack of digital skills, cognitive biases), processes (e.g., lack of standardization, time pressures), software (e.g., lack of conflict detection), and hardware (e.g., insufficient backup capacity). These threats directly impact three core dimensions of information quality: intrinsic (accuracy, validity), relational (relevance, coherence, timeliness), and security (access control, protection from unauthorized access). A resilient information lifecycle, therefore, requires more than just firewalls and antivirus software; it demands a holistic framework that integrates human, process, and technological factors.

5.2. The Information Resilience Framework: Capabilities and Requirements

The Information Resilience (IR) framework proposed by Blay et al. (2020) offers a structured response to these vulnerabilities. The framework is grounded in the theory that resilience—the ability to reduce vulnerabilities and assure quality amid threats—derives from a combination of proactive and reactive capabilities. Through a critical incident analysis of three UK BIM-enabled infrastructure projects, the authors identified key capabilities and requirements.

First, cognitive-driven capabilities of people are paramount. Information professionals and project stakeholders must employ cognitive abilities such as attention, reasoning, learning, and perception. Specifically, they need to act as “thinkers” (basing judgments on logic and objective analysis) rather than “feelers,” and as “judgers” (structuring and planning information) rather than “perceivers” (Blay et al., 2020). Behaviors such as sense-checking data, interrogating information, maintaining vigilance, and adapting to digital change are not innate; they are learnable competencies.

Second, process-driven requirements are equally critical. These include embedding validation checks, standardizing file-naming and audit protocols, providing clear definitions for levels of detail, fostering collaborative working environments, and implementing continuous monitoring. Importantly, Blay et al. (2020) found that existing standards like PAS1192-5 focused heavily on security at the strategic level but provided insufficient detail on the cognitive abilities of people or on processes that assure intrinsic and relational quality. The IR framework thus fills a gap by specifying that processes must also include digital upskilling, early-stage specification of information requirements, and automation to reduce human error.

5.3. Organising for Cyber Resilience: The Role of Governance and Networks

While the IR framework provides a micro-level view of capabilities and requirements, organizational and national governance structures provide the macro-level architecture for cyber resilience. Shalamanov (2019) addressed this by proposing a model for IT governance in the public administration and academic sectors, emphasizing effectiveness, efficiency, and cyber resilience (E2CR). Central to this model is the concept of network governance, exemplified by the proposed Academic CERT Association (ACERTA). ACERTA is a federated network of academic, research, and defense institutions designed to consolidate expertise for research, training, and consultation on cyber resilience (Shalamanov, 2019).

This organizational model directly supports the capabilities identified by Blay et al. (2020). For instance, ACERTA's focus on a "skills-first" approach, continuous professional development, and the use of a simulation environment (BEST-Cyber) for training directly addresses the cognitive and process gaps highlighted in the DAECO sector. Shalamanov (2019) argued that effective cyber resilience requires a PESTEL (Political, Economic, Social, Technological, Environmental, Legal) analysis and a maturity model to assess and improve IT organizations. The proposed structure—featuring a CEO, COO, CTO, and subject matter experts in policy, social aspects, and legal affairs—mirrors the multidisciplinary requirement identified by Blay et al. (2020), where information resilience depends on socio-technical enablers across multiple domains. Without such an organizational backbone, even the most well-defined individual capabilities may remain fragmented and ineffective.

5.4. Cultivating Self-Efficacy: The Psychological Engine of Re-Upskilling

The final, and perhaps most foundational, layer of cyber resilience is the psychological attribute of self-efficacy. Stavrou and Piki (2024) defined self-efficacy as an individual's belief in

their capability to produce afforded attainments—a belief that directly influences motivation, learning, and performance. In the context of cybersecurity and information management, self-efficacy manifests as motivation and self-awareness, curiosity and lifelong learning, dependability and attention to detail, and resilience, flexibility, and agility.

The urgency of cultivating self-efficacy stems from the massive skills gap in cybersecurity (3.5 million unfilled jobs globally) and the rapid obsolescence of technical skills. Stavrou and Piki (2024) demonstrated through a case study of a postgraduate cybersecurity curriculum that learning objectives can be explicitly mapped to self-efficacy attitudes. For example, requiring learners to perform a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of their own competencies directly fosters self-awareness. Guiding them to create actionable professional development plans cultivates dependability and attention to detail. Exposing them to cybersecurity skills frameworks (e.g., ENISA’s ECSF, NIST’s NICE) and industry newsletters builds curiosity and a lifelong learning mentality.

Crucially, self-efficacy is not a fixed trait but an attitude that can be fostered through pedagogical design. Stavrou and Piki (2024) found that 87% of learners who completed their efficacy-focused curriculum intended to maintain their professional development plans, indicating a lasting impact on motivation. This finding aligns with Blay et al.’s (2020) emphasis on cognitive-driven capabilities: attention, reasoning, and learning are all enhanced when individuals possess high self-efficacy. A professional who believes they can learn a new skill is far more likely to engage in the upskilling required to address emerging threats.

When these three perspectives are integrated, a clear synthesis emerges: Cyber resilience is not a product of technology alone; it is an emergent property of efficacious, cognitively skilled professionals operating within resilient organizational processes. Figure 1 conceptualizes this tripartite architecture.

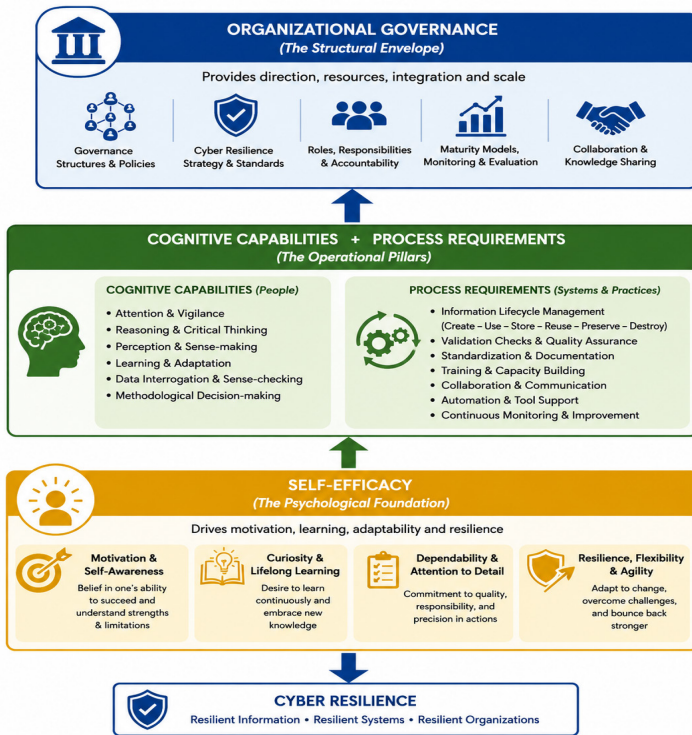


Figure 1: Integrated Conceptual Framework of Cyber Resilience

- **The Foundation (Self-Efficacy):** At the base lies self-efficacy—the motivation, self-awareness, curiosity, and resilience that drive an individual to learn, adapt, and persist. Without this foundation, upskilling efforts fail, and professionals revert to maladaptive behaviors (e.g., ignoring new threats, relying on obsolete knowledge).
- **The Pillars (Cognitive Capabilities & Process Requirements):** Upon this foundation rest the two pillars from the IR framework. The first pillar comprises cognitive-driven capabilities (attention, reasoning, sense-checking, methodological mindset). The second pillar comprises process-driven requirements (validation checks, standards, training, collaboration, automation).

- **The Envelope (Organizational Governance):** Finally, organizational and network governance (e.g., ACERTA, maturity models, CIO certification programs) provides the structural envelope that integrates, resources, and scales these individual and team-level factors. Governance ensures that self-efficacious professionals have clear roles, shared platforms, and pathways for continuous improvement.

Information professionals, therefore, must act as architects who design and maintain this integrated system. Their role extends beyond technical troubleshooting to include: (a) fostering self-efficacy within their teams through mentoring and reflective practice; (b) championing cognitive capabilities by promoting a culture of data interrogation and logical decision-making; (c) codifying resilient processes that reduce vulnerability at each stage of the information lifecycle; and (d) advocating for organizational governance structures that prioritize E2CR over mere compliance.

5.5. Emerging Technologies and Ethical Implications

The modern information lifecycle operates within a technological landscape increasingly dominated by emerging systems: Artificial Intelligence (AI), Machine Learning (ML), Generative AI (GenAI), and the Internet of Things (IoT). While these technologies catalyze organizational efficiency, they simultaneously introduce profound vectors of vulnerability that redefine the architectural responsibilities of information professionals.

5.5.1. Automated Threat Vectors and Deepening Vulnerabilities

Machine Learning algorithms and IoT ecosystems have vastly expanded the organizational attack surface. IoT devices, which continuously collect, process, and transmit data across institutional networks, frequently lack robust endpoint security, acting as weak gateways for network infiltration. Simultaneously,

Generative AI has weaponized the social engineering landscape. Threat actors leverage GenAI to execute hyper-personalized, automated spear-phishing campaigns and generate sophisticated deepfakes, bypassing traditional algorithmic filters and directly exploiting human cognitive vulnerabilities. Furthermore, data poisoning attacks where malicious actors subtly manipulate the datasets used to train institutional ML models can corrupt an organization's automated decision-making logic from within, rendering traditional relational and intrinsic information quality checks obsolete.

5.5.2. The Ethical Imperatives of Advanced Information Architecture

The deployment of these technologies introduces severe ethical anxieties that information professionals must navigate:

- **Algorithmic Bias and Discrimination:** AI and ML models trained on historical datasets inevitably inherit, perpetuate, and amplify human biases. Left unchecked, automated classification and discovery systems can systematically marginalize user populations.
- **Data Privacy and Intellectual Property:** Generative AI models often rely on massive ingestion protocols that can violate user privacy rights and copyright boundaries, absorbing proprietary institutional data or sensitive personal information into public black-box systems.
- **The Surveillance State vs. Ubiquitous Sensing:** The pervasive data-gathering nature of IoT devices risks turning institutional spaces into zones of continuous surveillance, compromising user confidentiality and intellectual freedom.

Information professionals must approach these technologies through a socio-technical lens, ensuring that data validation protocols include ethical audits, algorithmic transparency checks, and rigorous data provenance verification.

Cyber resilience can no longer just be about data preservation; it must encompass the ethical integrity of the automated systems manipulating that data.

6. Conclusion

As digital transformation deepens, information will remain a strategic resource and a primary vector of risk. The traditional, siloed approach of IT departments focusing solely on hardware or software security is no longer sufficient. This study has argued that true cyber resilience requires the deliberate cultivation of self-efficacy as the psychological engine, the explicit development of cognitive-driven capabilities and process-driven requirements as operational pillars, and the establishment of mature organizational governance as the structural envelope. For information professionals, this represents a significant elevation of their role: from passive custodians of data to active architects of resilience. Future research should focus on developing validated measurement instruments for self-efficacy in information-specific contexts and on testing integrated interventions that combine cognitive training, process redesign, and governance reform across diverse sectors. Only by addressing human, process, and organizational factors in concert can we build information systems that are not merely secure, but truly resilient.

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INFORMATION ARCHITECTS OF TOMORROW ADDRESSING THE DIGITAL TURN

About the Book

This edited volume, *Information Architects of Tomorrow: Addressing the Digital Turn*, brings together papers from the National Seminar organised by the College Librarians' Association Kerala (KCLA), in association with the Kerala State Higher Education Council (KSHEC) and St. Paul's College, Kalamassery, held on 22–23 May 2026 in Kochi, Kerala.

The book explores the evolving role of library and information professionals in the digital age, covering themes such as artificial intelligence in library systems, digital transformation, information literacy, research data management, cybersecurity, and sustainable digital libraries. This book is intended as a useful resource for librarians, researchers, teachers, students, and information professionals engaged in the rapidly changing landscape of library and information services.

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